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CONTENTS

Editorial: Rebuilding a Forest Empire in the Lake States 671
The Third Annual Summer Meeting 673
Foreword 673
Trends and Needs in Modern Wood Utilization 674
CARLILE P. WINSLOW
The Use of Chemicals in Forest Fire Control 677
T. R. TRUAX
Growth Rate and Position of Wood in Tree as Factors Influencing Kraft and Sulphite Pulps from Jack Pine 680
G. H. CHIDESTER, M. W. BRAY, AND C. E. CURRAN
Heredity Versus Environment in Improving Wood in Forest Trees 683
ARTHUR KOEHLER
Recreational Use of the Forest in the Rehabilitation of Cutover Area of the Lake States 688
RAY E. BASSETT
Forest Planting in the Lake States 691
H. BASIL WALES
Tree Planting on the Drier Sections of the Northern Great Plains 695
ERNEST J. GEORGE
The Meaning of the Lake States Forest Survey 698
R. N. CUNNINGHAM
Accomplishments and Probable Future of Private Forestry in the Lake States 701
GEORGE BANZHAF
The Viewpoint of the Lumberman on Selective Logging 705
O. T. SWAN
Financial Aspects of Forestry in the Lake States 711
D. M. MATTHEWS
Forestry Accomplishments in the Indian Service in the Lake States 717
WILLIAM HERITAGE
Silvicultural Management of Northern Hardwoods 719
F. H. EYRE
Undertones in the Forest Symphony 721
FRED W. LUENING
A Biotic View of Land 727
ALDO LEOPOLD
The Economist's Approach to Ecology 731
GEORGE S. WEHRWEIN
The Human Side of Land Use 735
RAPHAEL ZON
The Application of a Land Utilization Program to the Chippewa National Forest 738
CLARENCE E. KNUTSON
Land Use Adjustment Program of the Soil Conservation Service in the Upper Mississippi Valley 740
L. E. SAWYER
Some Phases of County Planning in Michigan 743
PAUL A. HERBERT
Accomplishments in Fire Protection in the Lake States 748
J. ALFRED MITCHELL
Forestry in Northeastern Wisconsin 751
R. B. GOODMAN
Forest Industries at Goodman 753
GEORGE A. HOUGHTON
Forest Management by the Goodman Lumber Company 754
JOHN A. CARR
Reviews 756

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EDITORIAL

REBUILDING A FOREST EMPIRE IN THE LAKE STATES

THE Lake States is one of the more interesting forest regions in the United States; interesting because of the high value of the original forests; interesting because of the rate at which these forests were utilized and the completeness with which they were cut; interesting because of the tremendous contribution these forests made to the development and well-being of the entire North Central region; interesting because of the large number of technical problems involved in forest restoration; and interesting because of the inadequacy and ineffectiveness of all attempts to restore the forests. In a real sense, the Lake States region is serving as a testing or proving ground for a great variety of legislative experiments and forest practices. In few forest regions are the difficulties confronting forest restoration greater; in few regions is more known concerning the basic problems involved; in few regions has it been more difficult to make significant progress. If and when, therefore, the forest problems of the Lake States are solved, it should not be difficult to find a solution for the more important forest problems of every other major forest region in the country.

The original forests of the Lake States were truly magnificent. Charlevoix had seen much country before he reached the Lake States region in 1721. Yet he was greatly impressed by its forests. "We are," wrote he, "in the midst of the greatest forests of the world, . . . there is nothing perhaps in nature comparable to them." About the middle of the last century lumbering in the Lake States began in earnest, first in Michigan, then in Wisconsin, and a little later in Minnesota. Despite the efforts of a handful of public officials, all obstacles to the acquisition and cutting of public timber by private individuals were overcome, and the resources of the region were exploited and developed according to the dictates of public opinion of the period. It would appear to be both futile and unfair to criticize what happened in the past in the light of present knowledge and conditions. The Lake States pioneer lumberman made a distinct contribution to economy of the period. The fact that new problems have arisen directly or indirectly because of his optimism, enthusiasm, and energy is no legitimate reason for condemning or even censoring him at this late date. More important is it that the present generation meet the problems that confront it with equal optimism, enthusiasm, and energy.

The once magnificent forests in the Lake States now have been largely cut. There remain only about 3½ million acres of old-growth and about an equal area of second-growth saw timber out of a total present forest area of almost 56 million acres. About 11 million acres are in cordwood, about 26 million acres are restocking, and on about 11¼ million acres the forest has been destroyed. To convert a forest of such area in such condition to one approaching a normal distribution of size and age classes is a tremendous task. To make matters still worse, through forest destruction the tax base has been largely destroyed, and tax delinquency of cutover land is rampant. Obviously because of its magnitude, the task of forest restoration is beyond the ability of the three states concerned to meet it. Other agencies, public and private, must participate and cooperate.

During recent years the tendency to shift responsibility to the federal government has become widespread. In doing this, adequate attention is not given to the fact that the federal government, in common with individuals, corporations, and state governments, does not have unlimited funds. Nor is adequate consideration

given to the problem of balancing the benefits from the use of funds for any particular purpose —forestry in this instance—against the benefits from other possible uses. To make matters still worse, as soon as the federal government undertakes an extensive program in the states, a cry often arises within the states that the federal government is usurping a large measure of the prerogatives of the states.

Viewing the problem dispassionately, it would appear that the federal government has more nearly met its forestry responsibilities in the Lake States region than has any other agency. It has established a regional forest experiment station which has made an outstanding contribution to the knowledge of existing forest problems. It has established a regional office that has prosecuted with enthusiasm and good judgment a program of acquisition and improvement of land for national forests. Within the period of very few years, it has acquired almost 5½ million acres of national forest land. It has made available hundreds of millions of dollars in Civilian Conservation Corps work for forest improvements in state as well as in national forests. It has participated liberally in the cost of protecting the forests in the region against fire. It has born the lion's share of the expense of white pine blister rust control and the control of other fungous diseases and insect pests. It has assumed a position of unquestionable leadership in all forestry programs in the region. Surely the federal government has not been dilatory in meeting its forestry responsibilities in the Lake States.

But what about state activity? Here the picture is not quite so bright, but nevertheless the forestry achievements of each of the three Lake States, considering all the factors involved, probably equal or excel those of all but two other states in the Union. It probably is not unfair to say, however, that state action has not been commensurate either with the magnitude of the task confronting these states, nor with their ability to cope with it both directly and indirectly.

A significant fact, and one that must ever be borne in mind in any approach to the forest problems of the Lake States, is that about 90 percent of all the forest land in the region is owned by private individuals and corporations or is in various stages of tax delinquency. In other words, the forest problems of the Lake States are concerned quite largely with privately owned forest land. The first line of trenches of forest action are on privately owned or once privately owned timberland, and it is here that all decisive battles will be waged.

One would be optimistic indeed to believe that sufficient public interest could be aroused to have public agencies acquire 55½ million acres of forest land or 45 percent of the total area in the Lake States. Even if this were possible, it is unlikely, in the long run, that it would be desirable. The acquisition of forest land by all public agencies may be a pallative but it is not a cure. Some semblance of forestry practice must be gotten on privately owned forest land. Until it is, the basic forestry problem of the Lake States will remain unsolved.

It appears to be quite generally recognized both by foresters and by timberland owners that under present economic, tax, and forest conditions few if any forest landowners in the Lake States can practice sustained yield forestry. There is no agreement even among foresters precisely what legislative changes will have to be made or can be made to set the wheels in motion. All that is clear is that private forestry must be made profitable before it will be undertaken by any large number of forest landowners. Songs of optimism, hymns of social significance, exhortations, prodding, even the threat of public regulation, have not and never will accomplish much in this region until certain fundamental difficulties have been overcome. The overcoming of these difficulties, in so far as they can be overcome, lies largely in the hands of the states and to a much smaller degree in the hands of the federal government. In either case foresters have a primary responsibility. The states must look to them for counsel, advice, and guidance. But it would appear that foresters have been unable to blaze even a comparatively safe trail of state action to promote private forestry.

By and large, lumbermen in the Lake States are a well-informed, public spirited, progressive group. They are eagerly awaiting the appearance of a Moses to lead them out of the Egypt of forest destruction into the promised land of sustained yield. Until the prophet appears, they are forced by necessity and circumstance to do the best they can in the social, economic, and legislative morass in which they find themselves.

The rebuilding of a forest empire in the Lake States lies quite largely in the future. May the coming generation of foresters tally more and greater accomplishments than the present generation has been able to tally.

THE THIRD ANNUAL SUMMER MEETING

THE third annual summer meeting of the Society of American Foresters was held jointly with the American Association for the Advancement of Science in Milwaukee, Wis., June 19-24, 1939. The Society met in five sessions, one of which was a joint session with the Ecological Society of America, in the Municipal Auditorium. Twenty-two technical papers were presented.

A foresters' banquet was held in the Milwaukee Athletic Club, June 20, with Stanley F. Wilson, U. S. Forest Service, acting as toastmaster. Remarks were made by C. F. Korstian, president of the Society, and by Henry Schmitz, editor-in-chief of the JOURNAL OF FORESTRY. The guest speaker was Fred W. Luening of the *Milwaukee Journal.*

Four days were devoted to field trips: June 22 to the Forest Products Laboratory, Madison, Wis., and June 23-25 to northern Wisconsin. Visits were made to the Terry Andrae State Park, the Nicolet National Forest, the Goodman Lumber Company mill and woods operations, plantations of the Wisconsin Conservation Department, the U. S. Forest Service nursery at Rhinelander, and to logging operations in the Menominee Indian Reservation.

Friday evening, June 23, the foresters were dinner guests of the Chamber of Commerce of Iron Mountain, Mich. Among the speakers were R. B. Goodman of the Goodman Lumber Company and M. J. Fox of the Von Platen-Fox Lumber Company, Iron Mountain, Mich. On Saturday the foresters were luncheon guests of R. B. Goodman and associates at Goodman, Wis.

Among those who contributed materially to the success of the meeting were the Program Committee, Henry Schmitz, chairman; the Committee on Local Arrangements, J. Herbert Stone, chairman; the Forest Service Girls Club of Milwaukee for arranging for the entertainment of visiting ladies; the Forest Products Laboratory; and the regional office of the Forest Service for assisting in many details.

Approximately one hundred members of the Society attended the sessions with twenty additional members participating in the field trips.

FOREWORD

THE cutover region of the Lake States is unquestionably one of the "problem areas" of the United States. For many years it was generally hoped, if not actually believed, by the people living within the region that agricultural development would solve most of the ills of the cutover area. Despite the fact that much of the land in the cutover area is potentially agricultural, the long looked for expansion never materialized. To make matters worse many improvements were made in anticipation of future development. Schools, churches, and other public buildings were erected; ditches were dug to drain swampy areas; roads were built; and power lines, telephone lines, and other public utilities were established. In brief, the region generally incurred obligations far beyond the capacity of the existing population to pay.

For many years the region floundered. As long as the prevailing thought in the cutover region was that it would ultimately become highly developed agriculturally and that there was little if any "forest land," little progress could be made. Only within comparatively recent years has this attitude changed. It is now generally recognized that although there are many areas within the region where agriculture should develop and now is developing, there are many millions of acres of land for which the highest immediate and prospective use is forestry.

The U. S. Forest Service has been active in the region for about thirty years. It has accomplished much. Each of the three Lake States has a highly organized efficient department of conservation. They too have accomplished much. During recent years many of the so-called New Deal agencies have attacked certain critical problems within the region. They are making significant progress.

The program for the summer meeting of the Society of American Foresters was designed primarily to record the accomplishments of the various agencies, public and private, engaged in conservation activities in the Lake States. The record is impressive and worthy of careful study by all American foresters, irrespective of the particular section of the country in which they may now be working. Forest regions which still have adequate reserves of saw timber might, if they only would, avoid many of the ills that now confront the Lake States.

MONDAY AFTERNOON SESSION, JUNE 19, 1939

SUBJECT: CONTRIBUTIONS BY THE FOREST PRODUCTS LABORATORY TO THE SOLUTION OF LAKE STATES FORESTRY PROBLEMS

Chairman: J. H. RICH

President C. F. Korstian gave a brief address of welcome and then introduced J. H. Rich, who served as chairman of this session. The chairman then called for the presentation of the following papers:

TRENDS AND NEEDS IN MODERN WOOD UTILIZATION

BY CARLILE P. WINSLOW
Forest Products Laboratory[1]

IF foresters accept the philosophy of future abundance of renewable forest crops from 1/4 to 1/3 of the total lands of the country, they cannot side-step acceptance of the importance—indeed vital necessity—of adequate and efficient utilization of these crops.

The magnitude of a natural resource does not in itself make a nation great or a civilization secure. Savages in the American wilderness managed only a miserable existence amid surroundings of natural wealth that have since enriched the world. Some of the most squalid conditions of existence in present society occur amid localities rich in natural but undeveloped wealth.

It is only through utilization, made possible by scientific and technological developments, and by the industrial application of these developments, that the great forest resources of the United States are now giving direct support to 6,000,000 people and contributing to the support of 2½ million farm families; that in the past tax returns on investments aggregating 10 billion dollars have been forthcoming; commodities valued at 3 billion dollars annually have been produced; and the public provided with a host of commodities needed for their daily comforts.

The outstanding feature, however, is that 95 percent of these products have come from private timberlands. These privately owned areas constitute three-fifths of all the commercial timberlands in the United States. To insure an economy of abundance, these lands must be kept under sustained forest management. There must, however, be a frank recognition that forestry on private lands can and will be practiced only when there appears a reasonable opportunity for profitable utilization of the crop; and that while the maximum extent of private forestry cropping is limited by the extent of the forest supply, it is controlled by the quantity of forest products which can be profitably manufactured and sold.

The same considerations apply with equal force to farm forestry. Upward of 15 percent of our land in farms consists of woods, while in some states woods occupy more than half of the farmland; forest products rank tenth in terms of income among the crops produced on farms, and in 1935 yielded farmers $69,546,000 in cash; wood products of much greater value are consumed directly on the farm. When one considers the fact that approximately 900,000 farmers in the United States earn a gross annual income of less than $400, and that a large portion of these farms is located in natural forest areas, the importance of potential income from forest products and employment is obvious.

UTILIZATION TRENDS

The important question is, are present utilization practices economical or wasteful? Efficient or inefficient? Contributing their maximum to general welfare or not? Holding or losing their markets? Promising well or ill for the future of public and private forestry? Examination reveals an unfavorable answer in practically every instance.

Losses and inefficiencies in the woods.—If all the available yield of the forest could be economically utilized with complete efficiency, the number of persons employed would be several times what it is at present, and products could be offered to the consumer in correspondingly greater volume.

Throughout the country is found a vast volume of logging wastes, which occur in the form of down timber, tops, limbs, trimmings, unmer-

[1]Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

chantable small logs, defective trees, and trees damaged in logging operations. This unused material aggregates annually some 3 billion cubic feet of wood, or nearly one-sixth of the Nation's total forest drain.

Coupled with this is an interlocked problem of nonuse. Prominent in this situation are the little-used or so-called "weed" species. They occur in practically all regions of the United States, and good forest management requires their utilization. New England, for example, is overrun with low-quality hardwoods. The South's pinelands are reverting to inferior quality hardwoods over extensive areas. In the Ozarks, a large volume of blackjack oak of poor quality gives little present aid to a population dependent upon the timber crop for support. This challenge to utilization is a stumbling block to successful forestry in all regions.

Losses in conversion and manufacturing plants.—In the operations of sawmills and remanufacturing plants about 2.3 billion cubic feet of wood are lost annually. Checks, cracks, splits, warping, twisting, and stain are the cause of large losses during seasoning. Severe seasoning degrade is a chief factor in the nonuse of some of the southern swamp-grown hardwoods. Loss in quality due to preventable stain and other degrade taking place during seasoning decreases the value of lumber in general by $10,000,000 annually and unsuits much of it for exacting uses.

Only one-half of the wood that goes into chemical pulp is utilized. Wood fiber to a value of $10,000,000 annually goes down mill sewers, suspended in the "white water" discharge. A total of 1,500,000 tons of lignin is annually discharged as waste pulping liquor into the nation's waterways.

These losses cost as much to grow as the material that is used. But they return nothing to the stumpage owner, nothing to the processor, practically nothing to employment, and they tend to increase the price of forest products to the consumer.

Service to the consumer.—Not all the wood used in construction and industry performs the service of which it is capable. Weak woods are sometimes used where strong woods are needed. Woods with poor wearing qualities may be used where traffic is heavy and wear excessive. Woods with high swelling and shrinkage properties are found in articles which give special trouble on this account. Woods with low resistance to decay are often used where decay hazards are high.

The home owner's bill for repainting houses and other wood structures is about $375,000,000 annually, but because of modified paint products he does not get the service from this expenditure to which he is entitled. Uncertain paint service reacts against the use of lumber for the exterior covering of houses, and wood substitutes so play upon its high cost that the consumer often turns to other materials, many of which cost more than wood.

Declining markets.—In view of the practices and results of timber utilization to date, the question about forest markets becomes all the more significant.

The answer, in simple terms, is that the market for lumber in general is declining in volume. The per capita use of lumber has decreased so that in the boom year of 1929 it was only slightly over half that recorded in 1906; since then it has averaged only about one-fourth. In the pulp and paper industry the per capita use of wood has greatly expanded in recent years; yet half of this expansion is in the form of foreign woods, despite the fact that our domestic woods are ample in quantity and quality to support the entire production. Had the 1906 per capita use of lumber been sustained, and had pulp and paper production been all from domestic woods, in 1929 the number of jobs from these great forest industries would have been about twice what it was.

In the future, a forest crop of more than twice the volume we are now using will be produced if our present forest lands are successfully rehabilitated and maintained. Such an outcome is hardly to be expected—certainly not from any private forestry efforts now in sight—unless present markets can be increased and finally at least doubled.

Other losses.—Superimposed on the foregoing losses are those resulting from scattered and diversified forest ownership, lack of integration of industrial operations, migratory operation rather than stabilized operation, inadequate mechanization, excessive transportation costs, and certain aspects of our tariff policy that are operating to the disadvantage of American forest industries and employment.

Remedial Measures

There are two basic ways in which the problem of American forest utilization can be met. One is by an adequate program of utilization research, and the other by means of extension and education. Both ways are at present grossly inadequate to meet the issues at stake.

Foresters might well take a leaf from the book of the agriculturist. Today agriculture (in addition to moneys appropriated by the states) is provided annually with federal funds amounting to some $35,000,000 to $40,000,000 for the major purpose of improving the value and marketability of agricultural crops and for extending their uses through education and extension.

Research—To return to the research phase of the utilization problem, records indicate that successful industries spend from 1 to 2 percent of the sale value of their product upon research. Predepression values of forest products aggregated 3 billion dollars annually. An expenditure for research of even ½ percent of this annual value of forest products would mean $15,000,000 annually. If it is recognized that almost one-third of the nation's forest lands is in government ownership, and that another one-third is in small scattered tracts largely owned by the farm and rural group, is it faulty to set the vision of the public carrying at least one-third of such a research program? This would mean a public research program on utilization aggregating at least $5,000,000 annually; at present it is only about one-eighth of that magnitude.

Such a program to improve present products and their methods of production, conversion, and use, and to develop new ones will require the combined efforts of competent specialists in a score of sciences; it will require the services of technologists conversant with such industrial operations as logging, sawmilling, fabricating and secondary utilization processes, building methods, wooden and fiber box making, pulp and paper, distillation, naval stores, preservation of wood against decay, insects and fire, painting, gluing, veneer cutting, and plywood manufacture. Especially urgent research needs lie in the fields of house and building construction, the chemical conversion of wood and wood waste, and the utilization of little-used species.

Good working clues are in the hands and heads of research men that offer prospect of meeting many of the needs enumerated. In this paper no attempt is made even to high-spot these clues.

There is the further need of developing new products from wood, in which improved mechanization and technical procedures may count more heavily. A recent analysis indicates that in the conversion of one million cubic feet of timber into lumber and planing mill products, 75 men are employed, $75,000 in wages are paid, and the resulting products are valued at $250,000; whereas, in the conversion of the same amount of wood into pulp and finally into a good grade of paper, the employees number 150, the wages are $200,000, and the finished products are valued at $900,000. Conversion of the wood into rayon carries these benefits still further.

This particular illustration points a general direction that forest industry should be following. It suggests the need for waste utilization and industrial integration, and for greater adaptation and refinement of products such as contemplated in the proposed research program.

In addition to the specific things already mentioned, there is need for attention and research in developing for the Nation a long-range study of the influence of transportation costs on the economics of distribution of forest products and their resulting influence on growing forest crops. The results of such a study should, through the Secretary of Agriculture, tie in with the Interstate Commerce Commission in regard to freight rates on forest products. This procedure would be similar in principle to that now authorized in the Agricultural Adjustment Act of 1938 for freight rates on agricultural products.

Further tax studies should be broadened to include measures to encourage good utilization. Also attention should be given to present tariff policies and reciprocal trade agreements, particularly with respect to pulp and paper, which do not encourage larger production and use of our domestic forest supplies.

Extension and education—On the extension and education phase of the problem, the machinery is already in existence so far as the agricultural group is concerned in the form of county agents, extension foresters, land grant colleges, and the like. Yet the machinery is faulty in that forestry receives but scant attention, and forest products utilization in particular gets practically none. Here again it is felt that an adequate appropriation is needed. As a beginning, at least one utilization extension man should be available in each of the states on a footing similar to state extension foresters. This would cost, with necessary travel and incidentals, about $250,000 annually. In addition to the farm group, there is the commercial timberland owner to whom extension and education services should be made available. This latter group requires the development of new extension procedures, but there should be no question of the desirability of providing it with a workable scheme, adequately financed.

THE USE OF CHEMICALS IN FOREST FIRE CONTROL

By T. R. TRUAX[1]
Forest Products Laboratory[2]

THE desire to employ all available ways and means of combating forest fires and to discover, if possible, any new materials of value, led the U. S. Forest Service in 1936 to undertake a study of the possibility of making effective use of chemicals. The investigation involved three steps: (a) review of the literature and search for promising materials, (b) laboratory tests to compare the effects of various compounds and to study variables in extinguishing fires in wood, and (c) field tests to compare results of the more promising materials on natural fuels of different types and arrangement. The primary purpose of this condensed paper is to summarize briefly the results of the field tests with chemicals in water solutions.

After a thorough review of the literature on various gases, liquids, solids, and foams, that have been used or suggested as fire extinguishers and retardants, some 40 different chemicals or combinations of chemicals in water solution were tested in the laboratory on a standard wood fire and with a uniform technique of extinguishing. The laboratory tests also involved different concentrations of solutions of the most effective chemicals, variations in rates of application of solutions and extinguishing under varying wind velocities.

The effectiveness of a chemical was determined by comparing the volume of its solution with the volume of water required for flame and total (flame and glow) extinction of similar fires. The results of the laboratory tests showed the solutions of some chemicals to be about twice as effective as water for total extinction. In tests with varying rates of application and wind velocities advantages as high as four times were obtained for the most effective chemical solutions in total extinction. A few chemicals showed superior flame extinction, but this advantage was largely lost in totally extinguishing the heavy glow in the wood test fires. Chemicals for field tests were selected on the basis of their showing in the laboratory tests.

More than two thousand field tests were made on grass and palmetto-grass fuels of the South; hardwood leaf litter of the Appalachian region, slashings of the Lake States, Appalachian, and Pacific Northwest; logs and branches, bracken, and rotten wood of the Pacific Northwest; and pine duff and brush of California.

Fires were set in the fuels in their natural arrangement and condition, where it was feasible and practicable to do so. This was true for all tests in grass, palmetto-grass, hardwood leaf litter, pine duff, and brush. Slashings, logs and branches, bracken, and rotten wood were artificially arranged, however, either because of their nonuniform natural distribution or on account of the hazard connected with burning them in their natural arrangement under the conditions prevailing at the time of test.

Direct Extinguishing Tests

The procedure used in direct extinguishing field tests was modified from time to time as the work progressed, experience was gained, and additional equipment became available. For most of the tests an experimental unit, consisting essentially of a small air compressor, pressure tanks for liquids, hose and nozzles, was employed. Various types of nozzles were used but one, which was adjustable over a wide range in rate of flow of liquid, was used extensively in the field tests. In some tests, back packs were used and in a few tests power pump equipment was employed. These were all included in a portable field laboratory containing a variety of equipment for preparing and applying solutions and foams and taking the measurements and data required.

In the early field tests, alternate fires were extinguished with chemical solution and water, respectively. Considerable difficulty was experienced, however, in obtaining successive fires of equal severity, due to wind conditions at the time of test and to other factors. A method of

[1]Acknowledgment is made to the Division of Fire Control for financing this investigation; to the various forest experiment stations and administrative units of the Forest Service and the Michigan Department of Conservation, for cooperation and assistance in making the field tests; and to members of the Forest Products Laboratory, particularly George M. Hunt, Arthur VanKleeck, Howard D. Tyner, and Bruce G. Heebink, who participated actively in the investigation.

[2]Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

making two tests simultaneously—one with chemical solution and one with water—was finally evolved in the later experiments. This method largely overcame the irregularity due to wind. The two fires started at the same time were extinguished simultaneously by two operators with similar equipment, one using water and the other chemical solution. For succeeding tests, the operators alternated water and chemical solution regularly, each extinguishing the same number of fires with each liquid in a series of tests.

Considerable care was exercised to have fires of comparable size and severity for extinguishing with water and chemical solution. Areas of naturally arranged fuels were selected to obtain as much uniformity as possible. Artificially piled fuels were selected to get uniform kinds and quantities of material and to have them arranged in like manner for corresponding water and chemical fires. With all the care used, however, it was felt that large differences were common in the test fires, particularly in the naturally arranged fuels. Furthermore, no constant relation between rate of application of liquid and size of successive fires could be attained and the wind velocity and direction fluctuated considerably, both during a single test and from one fire to the next. These variations caused wide fluctuations in the results in successive tests and series of tests that were intended to be alike.

In Table 1 are shown the average results obtained in the numerous field tests on different fuels with several chemical solutions and foams. The values, shown as superiority factors, represent the ratios of quantities of water and chemical solution required for total extinction of test fires. For example, a factor of 1.5 indicates that 50 percent more water was used than chemical solution in extinguishing the test fires. A range of values, as 1.2 to 1.6, indicates that the results varied as shown in different series of tests, made at different times and under somewhat different conditions.

While there are definite limitations to the

Table 1.—Comparative Effectiveness of Chemical Solutions and Foams in Direct Extinction Field Tests

Extinguisher		Superiority factors[1] based on volumes of water and chemical solutions used for total extinction on—								
Chemical	Concentration	Grass	Palmetto-grass	Hardwood leaves	Pine duff	Coniferous slashings	Logs and branches	Bracken	Brush	Rotten wood
	Percent									
Ammonium phosphate mono-	2.5	1.2		1.3		1.2–1.6				
	5.0	1.3–1.5	1.6	1.4		1.4–2.1				
	7.5	1.4				1.5				
	10.0	1.5		1.5	1.8	1.5–2.4	1.3–1.5	1.4	1.5	1.1
Ammonium sulphate	5.0	1.3		1.2		1.3				
	10.0	1.1	1.2	1.3	1.3	1.4–1.6				
	15.0					1.5				
Boric acid	2.5					1.2				
	4.0					1.4				
Calcium chloride	10.0			1.3		1.3				
	20.0					1.8				
Phosphoric acid	5.0	1.4								
Potassium bicarbonate	5.0	1.2			.6					
	10.0	1.4								
Potassium carbonate	5.0	1.2	1.3	1.3		1.0				
	10.0									
Sodium acetate	5.0	1.2								
Foam not loaded[2]—expelled as a liquid	9.0						1.2			
Foam loaded[2] –expelled fully expanded	16.4				0.5–0.8	.7	.7			
Foam loaded[2] –expelled as a liquid	16.4				1.1	1.1	1.6	1.1	1.4	1.6
Foam, Kempak (loaded)[2]	18.8				1.2–1.5	1.3	1.3			

[1]Superiority factors calculated by dividing volume of water by volume of chemical solution used in totally extinguishing similar fires. Different procedures were employed in conducting tests on the different fuels so that the values shown are not entirely comparable in all cases.

[2]"Not loaded" foam contained only foam-forming chemicals; "loaded" foams contained approximately equal amounts of foam-forming chemicals and fire-retardant chemicals.

data, because of nonuniform test conditions, certain important indications are nevertheless evident. Chemical solutions and foams show different results on different fuels. The pronounced glow-retardant chemicals, of which monoammonium phosphate was selected as representative, were most effective on the glowing types or combinations of glowing and flashy types of fuels, such as fresh pine slashings, but showed substantially increased effectiveness over water on all fuels tried, except rotten wood. Foams were of most value on logs and branches and rotten wood, where the burning surfaces could be coated with a continuous layer of the foam. In green slashings, bracken, and similar materials, where the fuel is thick and matted, the foam cannot be applied readily to the burning surfaces and has little or no advantage over water. In general, the best results with foam were obtained when the combined foam-forming and fire-retardant chemical solutions were expelled as a liquid or as a partially expanded foam. Considering the range of fuels and concentrations of solutions tested, monoammonium phosphate was the most effective material tested; furthermore, it is moderate in cost, appears to be otherwise suitable, and is the most widely applicable.

Pretreatment Tests

Field tests were also made in which the fuels were pretreated in advance of an oncoming fire. These tests were made in several ways to determine the value of chemicals in holding a line from which to backfire or to act as a barrier or firebreak. Of the chemicals tried, phosphoric acid and its ammonium salts were found most effective. In pretreated strips of grass and pine duff, in which the water was allowed to evaporate before test, moderately severe fires were completely stopped by the fire-retardant chemical. Lines freshly treated with monoammonium phosphate solution, from which back fires were set, were much more easily held than lines treated with water alone.

Significance

The results of both laboratory and field tests show that the extinguishing capacity of water can be increased or reinforced materially by the addition of certain chemicals, the increase depending upon both the kind of chemical and its concentration in the solution.

The superiority of a given chemical and concentration of solution over water is not a constant but varies with a number of factors of which (a) the rate of application in relation to the size and severity of the fire, (b) the wind velocity, and (c) the kind and arrangement of fuel are important. Dependent upon the conditions prevailing, the amount of chemical solution required may range from approximately the same as water to only a small part of the amount of water required to extinguish a fire.

Where an abundant supply of water is available and can be used, chemicals are not considered to have any worth-while application. Where water is scarce or difficult to get to the fire, or where the available equipment is scarcely adequate to cope with the fire, the intelligent use of chemicals can yield important advantages. In borderline cases, chemical solution may control or hold a fire where water fails, and chemicals may, in such cases, make all the difference between success and failure in an attack upon a forest fire. The use of chemicals appears most important in the early or initial stages of attack, through the use of back packs and tankers, and they probably have little if any application on large going fires, unless for use when back firing.

It is realized that only a few of the many chemical materials and methods of application have been investigated and that further research in the field may yield valuable results. However, miraculous results with chemicals are not to be expected nor are chemicals equally effective under all forest fire conditions. Furthermore, to utilize present known fire-retarding and extinguishing chemicals efficiently, further studies are needed to develop or adapt apparatus and methods for their application. It is believed, however, that the work thus far points the way to a new and useful weapon for the forest fire fighter that will ultimately assist him in his never ending fight against fire.

GROWTH RATE AND POSITION OF WOOD IN TREE AS FACTORS INFLUENCING KRAFT AND SULPHITE PULPS FROM JACK PINE

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MANY areas in the Lake States support large tracts of young jack pine. Some of these areas are now capable of producing a considerable quantity of pulpwood. Many others are at an age which should make them available in commercial size at about the time the supply of spruce and balsam fir will be greatly diminished. Some of the characteristics of jack pine that make it a particularly desirable pulpwood species from a silvicultural point of view are its relatively rapid rate of growth during the first 30 or 40 years and its greater adaptability to propagation in some districts than other conifers. It is highly desirable to find methods for a more extensive use of jack pine, both to supplement the diminishing supply of other pulpwood species and to maintain stabilized employment at established pulp mills and in the surrounding territories.

Jack pine is now used extensively in the production of bleached and unbleached kraft pulp in the Lake States. The maintenance of the present production and any further development in this region depend upon its ability to meet competition from other regions, notably the South, and from foreign countries.

The production of sulphite pulp from jack pine by the ordinary procedure presents certain difficulties generally attributable to the heartwood. Under the ordinary procedure the heartwood is not completely reduced to pulp, so that a relatively large amount of screen rejections and a low yield of pulp result. In the past, some jack pine has been used for the production of newsprint pulp. The results, however, have been somewhat unsatisfactory owing to these heartwood difficulties.

Experiments at the Forest Products Laboratory have recently indicated the possibility of much improved results with reasonably complete reduction of the wood by employing the customary calcium bisulphite liquor containing a relatively high sulphur dioxide concentration and a longer cooking time at lower temperatures.

For the application of practical cutting methods to obtain the maximum value from existing stands of jack pine, data on the volume of pulpwood, the costs, and the ultimate yield and quality of the pulp, as affected by different methods of cutting, are required. Other silvicultural factors to be considered are the annual growth, the mortality, and the reproduction as affected by cutting methods. The most effectual use of jack pine pulpwood requires a thorough knowledge of its pulping characteristics and corresponding wood properties, and the application of suitable pulping techniques. Such data should also be of considerable value in predicting costs and returns from actual stands before cutting.

To determine the most effective cutting methods for jack pine pulpwood, the Division of State and Private Forestry of the Region 9 (Milwaukee) office of the U. S. Forest Service recently conducted selective cutting experiments in cooperation with the State of Minnesota and a paper company. Cost and volume studies were made on approximately 400 cords of each of four degrees of cutting (approximately 30, 40, 60 percent and clear cutting) from a 48-year-old even-aged stand grown under natural conditions. It is planned to make further studies to determine the annual growth, the mortality, and the reproduction on each of the thinned plots over a 10-year period.

To enable accurate determination of the ultimate conversion value for each degree of cutting, physical and chemical measurements and pulp yield and quality determinations were made at the Forest Products Laboratory on selected samples of the wood.

Material Used

Pulping data were obtained on samples of about one cord each of 8-foot bolts from trees of several diameter classes (5, 7, 9, 11 inches d.b.h.). The top, middle, and butt bolts of the sample cords of each diameter class were segregated and representative samples of each were

[1]Acknowledgment is made to C. B. Stott, Division of State and Private Forestry, U. S. Forest Service, for assistance in planning the study and collection of the material.

[2]Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

taken for the pulping experiments. The corresponding wood properties, pulp yield, and quality were determined for each diameter class. The data thus obtained can be applied to the different degrees of cutting on similar age classes and site qualities when the amount of wood in each diameter class is known. In addition to the sample cords from different sized trees, one cord of bolts 3 to 4 inches in diameter and 8 feet in length was taken above the merchantable tops of woods-run material and included in the experiments.

The density, summerwood content, and heartwood content of the wood were found to decrease with increasing height in the tree. These properties, in general, also decreased with increasing diameter breast height. The weight of wood per cord decreased slightly with increasing diameter breast height; the lower density of the larger trees more than counteracted the effect of the greater volume of solid wood per cord.

In general, little relationship existed between the chemical properties and the position of the wood in the tree. However, with increase in diameter breast height the cellulose, alpha-cellulose, lignin, and pentosans were lower and the extractives were higher.

The various samples were prepared for cooking in the usual manner by chipping, screening, and mixing thoroughly to obtain representative samples of $\frac{5}{8}$-inch chips.

Cooking Conditions and Methods

Sulphate digestions were made in triplicate under identical conditions in spherical, steam-jacketed, rotary autoclaves of 3.7 gallons capacity.

The chips were cooked with a total of 20 percent of their oven-dry weight of a mixture of caustic soda and sodium sulphide in the ratio of two parts by weight of the former to one part of the latter. A linear temperature-pressure schedule was followed, allowing $1\frac{1}{2}$-hours to raise the temperature of the autoclave from that of the room to the maximum of 170° C., where it was held constant for an equal period, making a total cooking cycle of 3 hours.

Sulphite digestions were made in duplicate or triplicate by means of perforated baskets suspended in a 50-pound pulp capacity digester. The cooking conditions were determined by application as far as possible of the conditions previously found suitable for a commercial mill operation. After the main series was completed further tests were made to determine the time necessary for complete reduction of all types of wood.

In all digestions of the first series, therefore, the cooking liquor contained approximately 6.5 percent total sulphur dioxide with 1.25 percent combined. Approximately 75 gallons were charged per 100 pounds of wood. The maximum pressure was 80 pounds per square inch. The temperature schedule was as follows:

	Hours
Time to 110° C.	1.5
Time at 110° C.	2.0
Time from 110° C. to 136° C.	4.5
Time at 136° C. (3- to 4-inch tops	3.6
Time at 136° C. (Top	4.3
Time at 136° C. (Middles	3.8
Time at 136° C. (Butts	3.8
Total time (3- to 4-inch tops	11.6
Total time (Top	12.3
Total time (Middles	11.8
Total time (Butts	11.8

The low heartwood content of the tops, together with a higher moisture content, permitted a slightly longer cooking time to give a more complete reduction than was obtained from the middles and butts. The comparatively short time required for the 3- to 4-inch tops was undoubtedly a result of their low moisture content.

Strength tests were made on both sulphate and sulphite pulps according to the standard Forest Products Laboratory beater method. Unbleached sulphate pulps were analyzed for their cellulose, alpha-cellulose, lignin, pentosan contents, and their chlorine consumption. Unbleached sulphite pulps were tested for their chlorine consumption, and for their solubility in ether and in an alcohol-benzene mixture. Figures 1 and 2 summarize in graphic form the results obtained from the sulphate and sulphite experiments, respectively.

Sulphate Pulping

Although the data show that there are some differences both in yield and in pulp quality, all types of growth pulped equally satisfactorily by the kraft process.

The yields of screened pulp and screenings from the several locations in the trees of different diameter class deviated but little from the general average when considered on a weight basis.

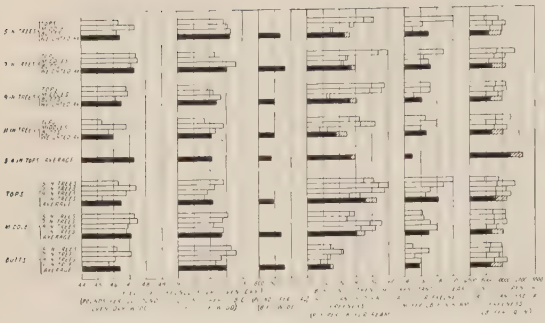

Fig. 1.—Yield and strength of sulphate pulps from top, middle, butt, and 3- to 4-inch top portions of jack pine trees ranging from 5 to 11 inches in diameter at breast height.

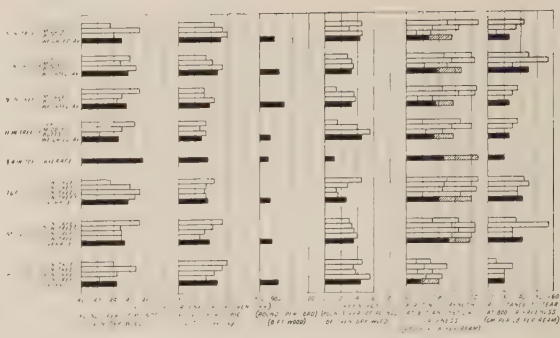

Fig. 2.—Yield and strength of sulphite pulps from top, middle, butt, and 3- to 4-inch top portions of jack pine trees ranging from 5 to 11 inches in diameter at breast height.

When considered on a volume basis, however, considerable variation both as to diameter class and as to position of bolt in the tree may be noticed. Because of the greater density of the suppressed trees and of the lower portions of all the trees, the yields per cubic foot of solid wood were, in general, considerably higher for this material than for the less dense material occurring in the more rapid-growth types and in the upper portions of the trees. On a cord basis the yields of kraft pulps were also appreciably higher for the smaller sizes than for the larger trees.

The chemical consumed in cooking the different types of wood varied but little from the general average for all the digestions.

Likewise, only small variations were found in the chemical composition and bleach requirement of the kraft pulps. Even though these differences were small, the strength properties of the kraft pulps (Fig. 1) showed rather wide variations both as to position of bolt in the tree and as to diameter class or growth rate. Position of bolt in the tree with its attendant differences in springwood content, in density, and the like, appeared to play a greater part in determining pulp quality than did growth rate. All the strength properties, including resistance to tear which usually decreases with increase in springwood, showed noticeable improvement in progressing upward in the tree.

Except for the tearing strength, the same trends in the properties of the pulps were found to apply in a general way to both sulphate and sulphite pulps from jack pine as were previously noted in pulping southern pines,[3,4] although the range of variation in the springwood content was, in the main, less than 10 percent. Springwood gave higher bursting and tensile strengths than did summerwood. Because of the collapse to a ribbon-like form of the thin-walled fibers of the springwood, the springwood pulp was more pliable and formed denser sheets having a finer texture, smoother surface, and lower porosity than the summerwood pulp. The low tearing strengths obtained from the butt bolts and the low bursting and tearing strengths obtained from the tops of the largest trees may be indicative of the influence of other factors, such as fiber dimensions or structure.

Pulps from the 7- and 9-inch diameter classes gave the highest average bursting strengths. The lowest tearing strength was obtained from the 9-inch class trees and from the 3- to 4-inch small top bolts. The small top bolts, however, excelled all others in tensile strength of pulps.

Segregation of the wood should be advantageous for the production of kraft pulps to attain maximum yield and quality with regard to specific properties.

Sulphite Pulping

Fairly satisfactory results were obtained by the sulphite process from the several types of jack pine with a 12-hour cooking schedule under the conditions employed. The screenings would probably amount to about 3.5 or 4 percent under these conditions from woods-run material. Increasing the time to 15.5 hours should reduce the screenings to less than 1.5 percent. Segregation of the wood would also be advantageous in decreasing the percentage of screenings.

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[3]Bray, M. W., and C. E. Curran, Paper Trade Jour., 105 (20) 39, November 11, 1937.

[4]Chidester, G. H., J. N. McGovern, and G. C. McNaughton, Paper Trade Jour., 107 (4) 32, July 28, 1938.

Although the differences in the yields of sulphite pulp on a weight basis from the different sized trees in the shorter cooking time were not large, slightly higher yields and smaller amounts of screenings were obtained from the two intermediate diameter classes than from the two extremes (Fig. 2). The yield of pulp per cubic foot of solid wood decreased as the diameter (rate of growth) increased; the yield from the largest trees was approximately 10 percent lower than from the smallest. On a cord basis the yields from the two intermediate sizes were appreciably higher than from the two extremes.

The differences in the strength of the sulphite pulps obtained from the different diameter classes were only slight. The ether extractives, indicative of the pitch content, were somewhat lower for the two intermediate classes.

It is believed that the results of both kraft and sulphite pulping for the diameter classes examined (5-, 7-, 9-, and 11-inch diameter breast height) can be applied with reasonable accuracy to different degrees of cutting on similar age classes and site qualities where the amount of wood in each diameter class is known. However, any application of the cord data may necessitate adjustment in the values for solid wood content.

On the whole, greater differences were exhibited by the sulphite pulp as well as the kraft obtained from different portions of the trees than by those obtained from the different diameter classes. The yield of sulphite pulp on a weight basis decreased from the tops to the butts and the amount of screenings increased appreciably. The yield on a volume basis increased from the tops to the butts. The strength of the pulps from the butt bolts was appreciably lower than from the middles or tops, while the solubility values were higher.

The most desirable wood for sulphite pulping, particularly for the shorter cooking time, consisted of the top portions of the larger trees, which might be supplemented by the middle portions of the smaller trees. The small tops below merchantable size gave perhaps the best results with respect to yield on a weight basis, amount of screenings, and strength. However, the yield on a cord basis was low as a result of the low density, and the cost of preparation would undoubtedly be higher than for the regular merchantable sizes.

Segregation for sulphite pulping according to diameter class should give slightly better results from the intermediate sizes than from the two extremes with respect to the yield on a cord basis, strength, and amount of screenings. This segregation would be slightly less advantageous than a selection of tops or including some of the middles, from the standpoint of strength and screenings, but would give a slightly higher yield on a cord basis.

HEREDITY VERSUS ENVIRONMENT IN IMPROVING WOOD IN FOREST TREES

By ARTHUR KOEHLER
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IT is generally recognized that within tree species there are distinct genetical variations in the fruit (apple), shape of leaves (cutleaf maple), color of leaves (Colorado blue spruce), mode of branching (Lombardy poplar), slenderness of branches (weeping birch), disease resistance (chestnut), frost resistance (red pine), yield of latex (hevea rubber tree), bark (black vs. "yellow" locust), shape of bole (Scots pine), and rate of growth (Douglas fir, Pacific Coast and Rocky Mountain forms grown under the same conditions). Similar striking differences in some respects can be found between hybrid trees and their parents. One specific difference of importance to foresters is the more vigorous growth of first-generation hybrids.

Relatively few definite cases can be cited, however, of genetical variations in the characteristics of the wood within a species. The indications are that spiral grain in pine (*Pinus longifolia*) and curly grain in birch in Finland are hereditary. Among reputed inherent differences in straight-grained wood of a species the following may be cited. Cricket bat willow, which is a hybrid, is said to possess superior qualities. Mountain trees are more resistant to breakage by snow than the

[1]Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

same species at lower levels, even when the two are planted side by side. Shipmast locust is said to have more durable heartwood of a deeper yellow color than the more common form of black locust. Douglas fir from the Rocky Mountain region is weaker and more resistant to penetration by preservatives than the Coast form, but in this case environment as well as heredity are different.

A parallel is frequently drawn between the vast improvements made in agricultural crops through selection and breeding and similar, although admittedly not so extensive, possibilities along forestry lines. There is one important difference, however, between agriculture and timber growing so far as genetics is concerned, which must not be lost sight of, and that is that in agriculture the primary aim is to produce fruits and herbaceous growth other than xylem, or wood, whereas in forestry wood is the main crop. There is ample evidence that wood is the most "conservative" part of the tree and therefore least subject to hereditary variations. Within a genus, two or more species frequently differ conspicuously in flower, fruit, leaf, and bark but show no distinctive difference in the wood, for example, certain oaks or pines. In the magnolia family, species of two distinctly different genera, namely, yellow poplar and certain species of magnolia, are extremely difficult to distinguish by the cellular structure of the wood.

With such conservativeness as between species, it is not very promising that many inherent pronounced differences in the clear wood will be found between varieties, races, and strains of a species, or a hybrid and its parents. Therefore, in forest genetics it seems likely that more progress can be made in breeding for drought, disease, insect, frost, and fire resistance, form of the tree, mode of branching, rate of growth, and possibly figured wood than in improvement in the cellular structure and chemical composition of the wood itself. Nevertheless that should not deter the forest geneticist from following up promising leads in improving wood quality since too little is known of the subject at present to make final decisions.

Assuming that hereditary differences in wood quality may exist in different varieties, races, or strains of a species, or between hybrids and their parents, it would be exceedingly difficult in many cases to prove that they are hereditary because environment has a very pronounced influence on wood quality and therefore may mask lesser hereditary differences. That environment independent of heredity has a tremendous influence on wood formation is shown by the large differences often found within the same tree. For example, Paul (*17*) found a range from 0.51 to 0.82, or 1 to 1.6, in the specific gravity of a cross section of pignut hickory, and Pillow (*19*) found a range in stiffness from 589,000 to 2,038,000 pounds per square inch, or 1 to 3.5, in the wood of individual test specimens from the lower and upper parts of a green ash tree that had grown on an inundated site.

The best test for determining whether heredity or environment is responsible for differences in trees of a species is to compare the different forms when grown under the same conditions as to site and stand. If two or more forms have different site origins, as geographic races, they should be compared under each site condition represented. The trouble with this procedure is that it takes trees a long time to grow to sizes in which the wood can be safely compared—small trees are not satisfactory because, as Gerry (*6*) and Bailey and Tupper (*1*) have shown, wood elements around the pith are smaller and it is not until 25 or even more rings from the center that the elements attain fairly constant size. Simplified methods for determining the probable quality of mature wood from young trees are badly needed.

In Table 1 most of the important variable features that influence the properties and usefulness of the wood of a species are enumerated, and an attempt is made to indicate which are known to be, or at least are said to be, influenced by heredity and which by environment, but no attempt is made to indicate the degree to which these factors influence them. No claim is made for completeness of or a high degree of accuracy in this table, since too little is known about the influence of either heredity or environment to be very specific. Nevertheless the preponderance of environmental influences seems to be well grounded quantitatively, and it is fairly well established that qualitatively numerous features, such as diameter growth, taper, knottiness, width of sapwood, width of summerwood, and slope of fibrils are influenced more by environment than heredity.

A great deal of emphasis in forest genetics in this country has in the past been placed on selecting or breeding trees of inherently vigorous rate of growth so as to shorten the length of rotation.

Desirable as rapid growth may be from the rotation standpoint, it may bring with it some un-

TABLE 1.—CASES OF HEREDITY OR ENVIRONMENT CAUSING VARIATIONS IN STEM FORM, WOOD STRUCTURE, AND CHEMICAL COMPOSITION WITHIN A TREE SPECIES

Variable features		*Influenced by*[1] *Heredity*	*Environment*	*Remarks*
Size:	Height	+	+	Effects of inherent vigor (*24*) and of site are well recognized.
	Diameter	+	+	
Shape of bole:	Crook	+	+	Some Scots pine is inherently crooked (*2* and *9*).
	Fork	+	+	Usually due to injury but also hereditary (*9*).
	Taper	+	+	Taper and form are determined by height growth and diameter growth at different heights.
	Form	+	+	
Eccentric cross section			+	Due to inclination of trunk or one-sided crown.
Knottiness:	Length of live knots		+	Determined largely by stand density.
	Length of dead knots		+	Determined somewhat by stand density.
	Number and distribution of knots	+	+	Distance between knot whorls depends on height growth.
Thickness of bark		+	+	(*25*)
Spiral grain		+	+	Although hereditary (*3*), the prevalence of spirally grained trees at high altitudes probably is due to natural selection on account of their greater flexibility under wind and snow loads.
Interlocked grain		+		Certain species characteristically have interlocked grain, indicating its hereditary nature.
Figured wood		+	+	Figured red gum said to be due to broken tops or branches. Figured birch has been found to reproduce itself in Finland (*7*).
Width of sapwood		+	+	A function of rate of growth (*16*).
Width of rings		+	+	A function of rate of growth.
Width of summerwood			+	(*12*, *13*, and *18*.)
Width of springwood			+	(*12* and *18*.)
Fibers:	Percent of volume		+	Fiber ratio decreases with reduction in rate of growth in same tree (*10* and *17*).
	Length	+	+	Vigor and injury affect length (*1*).
	Thickness of walls		+	(*13*)
	Size of cavities		+	Larger cavities in butts of ash and tupelo on inundated sites (*19*).
	Slope of fibrils		+	Greater slope in compression wood (*20*).
	Gelatinous inner layer		+	Abundant on tension side of leaning beech (*4*).
Wood parenchyma: Percent of volume			+	Injury frequently causes proliferation of parenchyma.
Rays: Size and percent of volume			+	Affected by light, temperature (*26*).
Pores: Number and size			+	Pore ratio increases with reduction in rate of growth in same tree (*17*).
	Open or plugged in heartwood	?	?	
Shake and rift cracks		?	?	
Compression wood			+	Secondary effect of wind, snow, etc. (*20*).
Compression failures			+	Primary effect of wind, snow, etc.
Pitch pockets and pitch streaks			+	More abundant in exposed trees (*14*).
Mineral streaks			+	Secondary effect of injury (*23*).
Bird pecks			+	Primary and secondary effects of injury.
Decay in living tree			+	Secondary effect of fire scars, wind breakage, etc. (*8*, *15*).
Frost rings		+	+	Secondary effect of cold (*22*).
Frost cracks			+	Primary effect of cold.
Extractives		+	+	Pitch deposits due to injury in pine. Osage orange in South has more extractives than in North (*11*). Coast cypress is darker than Inland cypress. "Yellow" locust heartwood more durable than black locust (*21*).
Chemical composition of cell walls			+	Compression wood has larger percentage of lignin (*20*). Tropical species more highly lignified than temperate species (*5*).
Green moisture content			+	Sinker butts occur in western red cedar along coast but not inland.

[1]Some factors, such as size, thickness of bark, length of fibers, etc., are influenced by age as well as heredity and environment. In such cases comparisons must be made at a given age of the wood.

desirable features. Wood of rapid growth usually differs in some important properties from that of slower growth, sometimes so much so as to be undesirable for many of the uses for which the species is commonly used. Some of the objectionable features of wide-ringed wood that have been observed are the following:

1. Lower specific gravity[2] (usually in softwoods) making the strength less and the yield of pulp per cord lower.
2. Higher specific gravity[2] (usually in hardwoods) making it more difficult to work and causing greater shrinkage.
3. Coarser grained, making it more difficult to work and causing uneven wear due to the presence of wide bands of springwood and summerwood.
4. Greater tendency to warp.
5. Wider sapwood.[2]

The question therefore arises whether inherently rapid growing forms have undesirable characteristics and if they do whether they are of the same magnitude as those of the ordinary forms when grown rapidly under specially favorable environmental conditions. If they are of the same magnitude, it would mean that those objectionable features are a function of rate of growth and that they would be even more objectionable in trees grown at rates faster than the usual forms will attain. On the other hand, there is a possibility that rapidly growing forms could be developed in which some of the objectionable features at least would not be so accentuated, although at present we know of no encouraging information to indicate that such may be the case.

In any event, rapidly growing strains for the most part will be grown in fully stocked stands (with allowance of some latitude in the meaning of "fully stocked") in which case they will not be growing at their maximum possible rate as individuals, but will be expected to do better per acre than their less vigorous relatives. Under those conditions some of the handicaps of extreme rapid growth may not develop seriously.

Encouragement, therefore, should be given to developing hereditary strains of trees or hybrids of good form having wood of desirable quality and as rapid a growth rate as is consistent with cultural and utilization requirements. In order to avoid profitless work in forest genetics and to concentrate as far as possible on the more promising lines of work, careful studies of the silvical and wood characteristics of new genetical forms should be undertaken as rapidly as their size will permit. On account of the variables involved such studies undoubtedly will require the use of advanced statistical methods.

Coordinate with genetics thoroughgoing studies of the effect of environment on timber quality should be carried on for the following reasons:

1. On account of the large influence that environment has on the growing tree and the concomitant possibilities of greatly improving the market value and usefulness of timber through cultural operations.
2. Such information is needed in forest genetics in order to distinguish properly between hereditary and environmental responses.
3. Improvement in timber quality through modification of environment can be put into practice immediately on the present crop of timber as well as future crops.

[2]These characteristics may at times be an advantage.

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TUESDAY MORNING SESSION, JUNE 20, 1939

SUBJECT: FOREST REHABILITATION IN THE LAKE STATES

Chairman: T. Schantz-Hansen

RECREATIONAL USE OF THE FOREST IN THE REHABILITATION OF CUTOVER AREA OF THE LAKE STATES

BY RAY E. BASSETT
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FOREST recreation plays an important part in local economics, and influences social conditions and standards of living in the communities in and adjacent to the forests. In many of the forest communities of the Lake States forest recreationists furnish, either directly or indirectly, nearly all the local income; in others, this business provides only a seasonal income, but this often is a substantial part of the total cash income, and with such other employment as logging in the nontourist season, enables the local residents to make a living.

The broad social values—aesthetic, recreational, and inspirational—cannot always be measured in economic terms. It is generally agreed by students of social problems and standards of living that the social and economic rehabilitation of many communities now prostrated by the combined forces of forest bankruptcy and economic depression lies in rebuilding the forest for sustained timber yields and related benefits; and that, pending its restoration, forest culture and development offer the most practicable and productive employment for the population now stranded in these forest regions.

The value of forests in supplying materials and energy has long been recognized. However, the social and spiritual contributions of forests to the national welfare have been given much less consideration, although they are perhaps more generally recognized by the American public than they are by foresters.

We have been thinking for a long time in terms of goods rather than of people; in natural resources rather than in human resources and needs. Society is now trying to establish the proper relationship between these two points of view. The impetus is coming from the people. Recreation is being reinterpreted. The people are beginning to see that the good life implies more than goods. They now believe that goods may be made accessible and at the same moment they begin to ask for something higher. They see that recreation may offer them the opportunity for free personal growth for which they have always longed. As a social movement recreation is about to take its place alongside education as a democratic prerequisite.

The backbone of the recreational industry, whether resort, campground, hunting, fishing, or some other form, is the forest, particularly the lakes and streams bordered by forest growth. If the forest did not yield a single stick of timber or a single stick of pulpwood, the use of the land for forests would still be economically fully justified. As a matter of fact, however, commodity utilization of the forests does not exclude recreational development, and the uses may be entirely harmonious. In correlating all the other major forest resources and primary objectives in forest management with the recreational resource, we find it possible to preserve for all time the use of the entire forest for recreation under the multiple use system and at the same time conserve and properly manage water, timber, grazing, and game resources—the basic values upon which recreation is so dependent.

Recreation, as a forest resource, is unique in that it is an intangible combination of things—scenery, fresh air, water, wildlife—which can be used, or sold, over and over again, providing, of course, the natural resources of the forest are properly managed and conserved. And, as the forests are open to public use, the local residents have the opportunity to sell, in a sense, something which they do not own; and in the selling that something is not destroyed, but on the contrary remains to be resold continuously.

Private enterprise can realize a tidy income even from mere camping and picnicking uses where only a few simple facilities are provided. No large capital investments generally are required. With a few crude tables, a little labor in clearing brush, the farmer is ready to rent picnic

and camping space. A home-made cabin can be rented. Thoroughbred horses are not needed for horse liveries. Boats are always in demand where there is water.

Inside the national and state forests the government constructs forest roads and improves the roadside for scenic values; improves the streams for human use and re-stocks lakes and streams with fish; restores, protects and administers forest areas; restores and protects game; advertises attractions and improves conditions for human use and enjoyment in many other ways—all at no direct expense to the local communities.

Recreation differs from other forest values in that it is increasing in importance at a rate more rapid than any of the others. Another important factor, particularly from the standpoint of land use, is that frequently land, which cannot be farmed and which may also be of low value for timber growing, may be utilized profitably for recreation. Where recreation can be developed on an area, it will generally pay considerably larger dividends than any other type of use to which the land might be devoted.

Considerable factual data on the extent of the recreation business are available. These are based on registations, railroad business, and highway travel counts. However, one of the best barometers of the effect of this business on the economics of forest communities is the visual circumstantial evidence of the commercial business activities during the tourist season as compared with the off season. Many activities cease during the season when recreationists' patronage is absent. Cabin camps, many gas stations and stores, curio shops, and resorts are closed.

The tourist season in northern Michigan, Wisconsin, and Minnesota is a short one not exceeding four months during which time the commercial recreation enterprises must get their income. Many do a profitable yearly business in this short four months' season. Because of this short season, the business is frequently affected by a late spring, rain, insect pests, or other unusual conditions.

Recently, with the development of winter sports activities in the northern forest area, many local towns and resorts are getting winter business; railroads are running special trains and a new and formerly untried business is now a reality. The state ferry business across the Straits of Mackinac between Lower and Upper Michigan is largely the result of summer tourists. On weekends and holidays the number of passenger cars often is very large.

Another indication of the part played by the forest in the recreation business is shown by the cancellation of reservations and wholesale exodus of recreationists where a large forest fire occurs in the vicinity. Such a situation represents a big loss to local communities affected.

State-supported travel and tourist bureaus and state departments of conservation and highways recognize the monetary values of recreationists to local communities. These agencies advertise extensively and feature forests in their advertising. Estimates indicate that, as a result of recreation, at least 250 million dollars are spent annually in communities in or adjacent to national forests of the United States. Recreation is considered the second largest industry in Michigan—a business of 400 million dollars annually and second only to the automobile industry in that state. In Wisconsin, recreation is now on a par with dairying, a 250 million dollar business, which has made Wisconsin famous as its formerly outstanding industry. In Minnesota, recreation ranks third. The number of visitors to the national forests in 1917 was estimated at three million. During 1938 more than 30 million visits to national forests were made by sightseers, campers, picnickers, resort and summer home visitors ,hunters, fishermen, hikers, horseback riders, mountain climbers, winter sports enthusiasts, and others.

During 1938 in the national forests of the cutover area of the Lake States, approximately 600,000 persons used the forest recreation improvements and facilities while more than 900,000 additional visitors were classed as sightseers and 3,500,000 others used the highways through the forests enroute elsewhere. The U. S. Forest Service expended during 1938 more than $600,000 for recreational improvements in the cutover region. At this date, there are over 200 developed camp and picnic grounds; 6 government constructed organization camps for public use, 2 others under construction; 16 private organization camps under special use permit and 135 private organization camps on private property inside national forests, with a total daily capacity of constructed organization camps of more than 10,000 campers; numerous resorts, lodges, summer homes, winter sports areas, trails, canoe routes and other forms of recreational development.

Since many tourists cross a large part of a state

to reach a national forest, the whole state shares in the economic benefits of the tourist traffic even though the time spent in transit is short. The American Automobile Association estimates that the tourist expenditures are about as follows:

Merchandise 26 percent.
Restaurants and cafes 20.5 percent.
Hotels and rooms 17.3 percent.
Auto accessories, gas and oil 11.5 percent.
Amusements 8.5 percent.
Rail transportation 7.0 percent.
Confectionery and incidentals 5.0 percent.
Carfare, taxis and busses 3.3 percent.

On the Nicolet National Forest in northern Wisconsin the expenditures of tourists are estimated conservatively at 4½ million dollars annually, of which more than 2 million is spent in the county and the balance accrues to the rest of the state.

The employment of local residents as guides, servants, laundresses, caretakers, and for other types of service is a source of income. The recreation business provides markets for local farm produce and articles of local manufacture. As 20 percent of the tourist expense goes into transportation, most of which is by car, there is created an enormous business in gas, oil, auto supplies, and repairs.

Recreational developments and substantial expenditures by recreationists broaden the tax base and thus lighten the local tax burden. Good examples of this are state sales and service taxes; gasoline taxes for road building and maintenance; fishing and hunting licenses; increased land values, especially of land which without the tourist trade would have little value.

The relative importance of recreational land in the tax base is of great interest. In Oneida County of northern Wisconsin on the Nicolet National Forest, resort property represents 37.2 percent of the real estate tax base of the towns, or 21 percent of the tax base of the entire county with the City of Rhinelander included. In Vilas County, the 15.7 percent of the county in resorts and homes represents 63.1 percent of the assessed value of the real estate of the towns, or 56.3 percent of the whole county, including the City of Eagle River.

A study was made a few years ago in 189 cutover land resort townships and two cities of Lower Michigan, and the share of township tax burdens borne by recreation properties were found to be greater than 30 percent in two-thirds of them and as high as 85 percent of the total township tax in two townships.

Another fact of importance regarding taxes on recreation lands is that the taxes are usually paid promptly and tax failures are fairly uncommon among recreation landowners though this is not the case with other types of land ownership.

The tax productivity of recreational property as compared with farm property is vividly portrayed by the Michigan Equalization Board annual reports of the assessed values of all Michigan townships. A study of the cutover land reports for the half decade (1926-1931) supports fully the claim that recreation townships keep up higher values than do farm townships.

The relation of the recreational landowners to local governments is a peculiar one. They pay taxes, but being summer residents only for the most part they do not vote there and their children do not attend the local schools. So while they are paying taxes to support the schools, the tourists make few demands upon them. On the other hand, they use the roads and consequently place heavy demands upon adequate transportation systems.

Fishing and hunting licenses are an important revenue producing asset where thousands of licenses are issued each year in each state. In Wisconsin alone, more than 225,000 hunting licenses are issued annually.

A further source of income to the forested counties is a 25 percent return on the receipts from government leases on special uses.

The State Highway Commission of Wisconsin made a traffic survey in 1931 in the forested part of the state and found that 14 percent of the tourists were enroute to other states, 19.7 percent came to visit friends and relatives, 11.3 percent came on business, leaving 55 percent who reported that they came to spend their vacations, to enjoy the scenery, or to motor on the roads. These statistics do not include those who came by lake steamers, airplane, or railroad. Railroads bring thousands of people, shown by the fact that Vilas County, Wisconsin, reported an expenditure of over $321,000 for railroad fares in 1930. During the tourist season, special trains are run to the resort towns and daily airplane service is maintained between Chicago and the Highland Lake Region. All this tends to improve train, bus, telephone, and mail services. Contact with the "outside" world is improved which has

its influence, both directly and indirectly, in improving social conditions and higher standards of living.

Local purchasing power is enhanced by improved business conditions. Likewise, with the increase in permanent residents among recreationists comes an influx of professional people, such as doctors and dentists in addition to the trades and service types of employment.

The recreation industry alone is not a panacea for all ills, but it can be said to be the immediate life saver. In the final analysis, the way out for the cutover area of the Lake States seems to be through the rearrangement of its pattern of settlement, making the most of its possibilities for agriculture and the restoration of the forests, which were the original great resource, while taking full advantage of the immediate economical and social opportunities offered by recreation and its related industries.

FOREST PLANTING IN THE LAKE STATES

By H. BASIL WALES
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FORESTERS in general are familiar with the logging history of the Lake States region, and it should be unnecessary to outline what has happened and what, in many places, is continuing to result in a destruction of resource values, in declining communities, in underfinanced local governments, and in a pauperized people. It should, however, be understood that the entire area is not in a devastated condition, nor are all the communities declining, nor all the people pauperized. Notwithstanding destructive logging practices, and notwithstanding indiscriminate and repeated burning, there is still some virgin timber; there are many thousands of acres of naturally regenerated second growth; and there are many communities which have developed other industries to take the place of the logging and milling industry.

It is not my intention, through definite statement or even by implication, to try to fix the responsibility for the present condition of the vast cutover area, which extends as a belt of varying width across the northern half of the three Lake States from the "Soo" to the Lake of the Woods. It resulted undoubtedly from the philosophy of the times, and the fact that a rapidly expanding nation required lumber and timber, and more lumber and timber, in its development program. The lumbermen and the entire citizenry were sincere in their belief that the supply of timber was inexhaustible, and that logging would be followed by a necessary agriculture so that food might be produced for these people. We now know that this theory was fallacious. The inexhaustible has been practically exhausted, and the soil has demonstrated that it is not adapted to a permanent agriculture.

But let us not lament the past. It is gone forever. The present is with us. We must face conditions as they are, and look to the future with courage.

Land economic surveys have been made, and many piecemeal studies have attempted to find a solution, but it was not until last year that a comprehensive study was made of the vast cutover problem area throughout the Lake States region, in an effort to build up a correlated plan of action for the ultimate restoration of resource values and the rehabilitation of a dependent people, communities, and industry. The Great Lakes Regional Planning Committee, appointed by the National Resources Board, and the several state sub-committees worked diligently in assembling the facts, in analyzing the data, and in developing a fully correlated plan of action. It is my intention, not to discuss the report of that committee, nor even to summarize it, for it has not yet been published, but simply to point out that reforestation was given a rather vital part to play in bringing about, both in the immediate future and in the years to come, stabilized communities and a happy, contented citizenry. The one outstanding immediate necessity is an opportunity for the local people to earn a supplemental income, and since approximately 75 percent of the cost of reforestation consists of wages, it can readily be seen that reforestation can be of immediate assistance.

In spite of continued efforts towards the development of other land uses, the great cutover region is still essentially a "wild" land area. Only about 10 percent of its 57,000,000 acres is in crop land. Forty-five million acres are still in forests of one sort or another. Some 7,000,000

acres have been deforested through destructive logging and fire, or through clearing for ill-advised agriculture. Of the area supporting second growth, approximately 65 percent is in types where "weed" or lesser value species predominate. Some 12,000,000 acres are so lightly stocked with valuable species as to require either conversion or partial planting if they are to be reasonably productive of timber values. Some of this area will restock naturally, but it can readily be seen that an appalling task of planting more than 15,000,000 acres lies ahead in the three states, if the land is to become productive of timber values.

Is it necessary to restore a productive forest on every acre of forest soil? We might argue that question for a day and still not reach agreement. However, when I have to pay four to five cents per foot for No. 1 common lumber, shipped in from the West Coast; when I read of the number of new housing units required to house our people properly; and when I note the condition of farm structures in the permanent agricultural areas as I travel throughout the nine states of the North Central Region, I am not greatly perturbed by the fact that some day in the distant future we might have close at hand an abundant supply of timber of a reasonably good quality. The counties up north will not be in virtual receivership, by reason of a good timber stand on land now idle and, most likely, tax-delinquent, nor will the people up there be pauperized by having an abundance of timber in which to labor and receive an income through harvesting the crop and fabricating the raw materials.

Let us return to the question of whether it is necessary or desirable to restore, by planting, the denuded areas, and to maintain a productive forest on every acre of forest soil. The answer is most emphatically, no. Conservation is wise use, and if it is wise use of the land resource to hold it more or less in its present denuded condition for prairie chickens or deer or other wildlife, either as a refuge or as public shooting grounds, then by all means let us not destroy the basis of a valuable resource by planting a forest of valuable timber-producing species. We may plant portions of it to game food species or to coniferous cover to improve habitat conditions. Such land will pay its way, either through the taxes paid by hunting club owners or through more or less intangible public benefits.

Some of the area requiring planting may be so located as to be inaccessible, either from the standpoint of an economic planting job or, possibly, an economic harvest of the resulting crops. Even so, wise land use may dictate some planting for wildlife purposes or for seed tree purposes in the course of nature's own development. Some soils may be so low in productive capacity as not to warrant a job of planting for timber production. Other areas may be needed as summer range to supplement a farm unit and help make the farmer self-sustaining. What I am endeavoring to point out is that sound and wise land-use planning is basic to any program of reforestation or forest management. Not only this, but the planting effort must be gauged on the objective or end to be reached, and also must give consideration to the other resource values which may be inherent in the area. A private owner may reasonably expect maximum timber production, if that be his objective, but within an area allocated to timber production on a publicly owned forest, it is not essential that the timber production be on a maximum basis. Wildlife openings and edges on an adequate pattern are desirable, so that timber production and wildlife values may be on a fully correlated optimum basis rather than on a maximum and a minimum basis.

Recreational values are inherent in the forested area. Landscape architects uniformly object to the obvious artificiality of regularly spaced planted trees, particularly along scenic roads. To me and, judging from the many favorable comments, also to a great many recreational visitors, such areas, a very minor part of the whole roadside areas in the north woods, are appealing, but nevertheless irregular spacing can be used, and a mixture of species will probably improve scenic values. Aside from this apparent conflict, and the need for occasional openings or breaks in the solid forest canopy for scenic purposes, recreation is, to a very large degree, dependent upon a forested area. Hence there can be but little conflict between recreation and planting.

There are now some 20,000,000 acres in public ownership in the three Lake States, and the area is being added to each year by federal purchase or through the tax delinquency route. Although national forests, state forests, and county forests, set aside for public purposes, and to be administered as such, were probably not in all cases carefully studied from the land-use standpoint, they are, by and large, well suited for forest purposes. Within these publicly administered forests there are excellent opportunities for working out detailed land-use plans and the carrying

forward of a comprehensive reforestation program on a plan-wise basis. Much has already been accomplished, as I shall presently point out, but considering the immensity of the program the surface has just been scratched.

From the standpoint of the private owner, reforestation does not appear to be attractive, as evidenced by the increasing amount of tax-delinquent land which is coming back to public ownership, and the fact that I have been able to obtain a record of only 3,587 acres in Michigan and 14,779 acres in Wisconsin reforested by private industry. The figures for Minnesota were not available, but I know that only a very small acreage has been planted. I was able to find a record of but two privately owned forest tree nurseries which are maintained and operated by industry for the purpose of producing their own planting stock. These nurseries have a combined capacity of approximately 3,000,000 trees annually, but are now operated at about two-thirds of their capacity.

The record of accomplishment within publicly owned forests is much better. Shortly after the turn of the century, Michigan and Wisconsin recognized the need of entering upon a reforestation program, and established state nurseries at Higgins Lake and Trout Lake respectively. The U. S. Forest Service entered the field a few years later by developing what is now known as the Beal Nursery in Michigan, and the Cass Lake Nursery in Minnesota. Minnesota entered the field much later through the establishment of the Badoura Nursery. Prior to 1933 there was little expansion in either state or federal nurseries.

Beginning in 1933 with the inception of the Civilian Conservation Corps and other emergency programs, a very rapid expansion of publicly owned nursery capacity has resulted in a greatly increased planting program. The Forest Service expanded the three nurseries which were in existence at that time, and developed eight new nurseries. The combined annual capacity of the Forest Service nurseries on a 2-0 stock basis is around 300,000,000 trees, but since a very large proportion of the stock is transplant, the actual productive capacity is reduced to 100,000,000 trees, or enough to plant 100,000 acres per year.

Michigan has expanded the Higgins Lake Nursery to a productive capacity of approximately 20,000,000 trees annually, a very large proportion of which is 2-0 jack pine, and also has under development the Hardwood Nursery located near Wolverine, which is now producing 719,000 trees annually, but which will have a capacity of 3,750,000 trees when the development is complete. As the name indicates, this particular nursery is largely for the production of hardwood species, which, it is anticipated, will be used to a large extent for the establishment of game food and cover.

In Wisconsin, the Trout Lake Nursery is now rated at an annual capacity of 10,000,000 trees, the Central Nursery at 25,000,000 trees, and the Gordon Nursery at 10,000,000 trees. The new Athelstane Nursery in Marinette County will have a productive capacity of 200,000 trees. These nurseries are operated by the Conservation Department and produce trees for distribution to farmers and other private owners, schools, and municipalities, as well as for planting on state forests. Approximately 10 percent of the stock produced is transplant, the balance being two and three year old seedlings.

In Minnesota the Badoura Nursery is being built up steadily, and it is anticipated that it will reach an annual production of 10,000,000 in 1940. Two new primary nurseries are also being developed, the Owen Lake Nursery to a capacity of 5,000,000 trees and the Gheen to a capacity of about 450,000 trees. This state has also developed eight secondary nurseries, small areas of two to three acres set aside as game food nurseries or as transplant nurseries. These are operated entirely for the production of stock for planting on state land. The Division of Forestry has recently acquired 320 acres of land upon which it is planned to develop a new primary nursery second only to the Badoura Nursery in that state. The total estimated stock production in Minnesota for 1939 is 8,935,000 trees.

The development of nursery capacity and the production of trees in the nurseries has been a big accomplishment, but it is simply a means to the end. Reforestation accomplishment can only be measured by the acres of successful plantations. Within the eight national forest units of the three Lake States the Forest Service has planted a total of 420,406 acres. At the close of 1938, 361,723 acres, or 88 percent of this initial acreage, were classified as successful; that is, having an average stocking of at least 250 trees per acre, reasonably well distributed. To reach this total of successful plantations, it has been necessary to replant approximately one-third of the original acreage. However, the criterion of

a successful plantation for replant purposes is not a minimum of 250 trees per acre, but for the North Central Region has been set at a minimum of 400 trees per acre, including natural reproduction as well as planted trees. It was unfortunate that the big expansion in reforestation work coincided with the culmination of a distinct drouth cycle. The years 1927, '29, '30, '31, '33, '34, and '36 were years of sub-normal precipitation, at least during the growing season. The culmination of the drouth in 1936, together with the extreme heat for a protracted period during July and August, resulted in extremely heavy losses in all plantations established in 1934, '35, and the spring of '36, and seriously affected some plantations established as early as 1930. This was particularly true on the Huron National Forest in Michigan.

In so far as state conservation departments are concerned, Michigan leads in planting accomplishment, having planted 214,344 acres on state forests and some 6,484 acres on other state land. In addition, some 40,000 acres have been replanted. The state claims to have 164,368 acres of successfully established plantations, leaving some 50,000 acres as an existing replant job.

In Wisconsin, the excellent start made in 1906 came to an abrupt end in 1914 when a court decision invalidated the forestry law. A new constitutional amendment in 1927, which was upheld in the state court, recreated the Conservation Department and enabled the state to begin where it had left off some 13 years before. The application of the forest crop law to county-owned land was also a factor in reforestation accomplishment. At the close of 1938 there had been planted on state forest areas 30,586 acres, on other state land 596 acres, and by counties and other municipalities 38,418 acres. It is my understanding that little replanting has been done, hence the acreage of successful plantations at present totals only 44,477 acres.

It has not been possible for me to secure a definite statement of the acreage planted on state land in Minnesota. However, nursery production has been very limited until the immediate past, and probably the total accomplishment will not exceed 15,000 to 20,000 acres. The Division of Forestry reports that 6,906,209 trees were planted in 1938. Figuring on the usual basis of 1,000 trees per acre, approximately 7,000 acres were planted in that year.

The Indian Service also has done some planting in the Lake States. The acreage figure is not available, but if we allow 20,000 acres, the total planted by public agencies will be almost exactly three-quarters of a million acres planted to secure the establishment of approximately 600,000 acres of successful plantations. It is doubtful if any other region in the United States can approach even closely to this figure.

The successful establishment of 600,000 acres of plantation is not the only entry on the credit side of the ledger. The development of nursery capacity to approximately 200,000,000 trees per year foretells an annual accomplishment of 200,000 acres per year in the near future. Even at that rate thousands of acres must be "held in cold storage" for a long period of time and left to nature to develop as she will, and to serve as public hunting ground or other wildlife areas.

Another item on the credit side of the ledger is the experience gained through thirty years of planting effort and definite research effort. We have learned that repeated fires have deteriorated site quality; that species must be fitted more closely to sites by studying pH value and colloidal content, herbaceous as well as shrubby and tree cover, exposure, water table and soil moisture conditions, and even the white grub population in the soil; that ground preparation by means of scalping costs three to four times as much as by furrowing and is at least 50 percent less efficient in terms of actual field planting costs and survival; that more sturdy stock with a better balance must be used and must be properly planted to withstand rigorous conditions brought about by sub-normal seasons or excessive vegetative competition; that survival is best under some cover, but that this same cover may become inimical to final successful establishment; that planted trees must be given sunlight and room to grow by removing overhead shade and low vegetative competition, else survival drops to the vanishing point; that plantation care is more important than the mere planting of trees.

With the knowledge gained, plantation establishment should be much more successful in the future and replanting should be reduced to a minimum. A larger annual program is desirable, not only from the land-use standpoint, but for the purpose of providing employment for dependent residents in the north woods country on a self-liquidating project.

TREE PLANTING ON THE DRIER SECTIONS OF THE NORTHERN GREAT PLAINS

By ERNEST J. GEORGE
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TREE planting, in common with the growing of other farm crops on the northern Great Plains, often is called a sorry mixture of mistakes and abuse of natural resources. Some people remind us of the Indian who, during the early years of settlement, informed the farmer he was leaving the sod "wrongside up." Other people, especially in more recent years, have suggested that it might be more advisable to remove the farmers from the so called "dustbowl" of the northern Great Plains than to spend money in maintaining a failing agricultural economy.

It is not the purpose of this paper to discuss the merits of these suggestions. Its purpose is briefly to state what has been accomplished by tree planting in improving and making more pleasant conditions around the farm home. Many farm homes are going to remain in this region regardless of whether they are dependent on raising agricultural crops, or whether they are, as now commonly advocated, dependent on raising livestock and with the sod "rightside up."

The northern Great Plains region may be roughly defined as that portion of North Dakota and South Dakota lying west of the 100th meridian and the prairie sections of Montana and Wyoming lying east of the Continental Divide. The region lies immediately west of the northern zone of the Prairie States Forestry Project.

Annual precipitation in the region averages around 15 inches or less. A large percentage of the rains fall in small quantities and are of minor benefit to trees and farm crops. Temperatures reach extremes, official Weather Bureau readings of 124° and —60° F. have been recorded in the region. The evaporation rate from a free water surface for the six months, April to September, averages approximately 34 inches at the Northern Great Plains Field Station, Mandan, N. Dak. The region is subject to almost constant winds, some of which are of high velocity.

The soils of the region fall predominately in the chestnut group of soils. This group has a profile of dark brown soil, changing at a depth of 1½ to 3 feet into a white calcareous horizon. Within this group may be found several soil series and all ranges of texture from sand through silt to clay. Native vegetation is the mixed tall and short prairie grass.

Natural tree growth is largely lacking except on some of the more hilly sections which are more or less covered with stands of conifers, and along streams and ravines which have mixed stands of hardwoods. Many reasons have been advanced to explain the lack of tree growth elsewhere and the inability of reproduction to encroach upon the grassland. All writers, however, usually agree that deficient precipitation is one of the major limiting factors.

The forester growing trees on the northern Plains must be prepared to change the technique used in more favorable parts of the country. He must develop or learn silvicultural skills which will be peculiar to that part of the country only. These techniques may of necessity have to be changed from time to time, but in the long run they will involve forestry, soils, and agronomic sciences. Trees on the northern Great Plains are another farm crop, and any other concept usually will result in difficulty.

The question is often asked, "Why attempt to grow trees in an area where a recalcitrant nature has failed to do her part?" The answer whatever it may be should always include that it is not proposed to produce commercial forests on the Plains, nor is it expected that the farmwoods will produce all the wood products needed for home consumption. Tree planting on the Plains is not for wood production. It is to protect the farm home from the ravages of winter winds and drifting snow, to provide winter and summer shelter for livestock, and to protect fruit and garden crops from hot, burning winds. The returns in actual dollars and cents may be difficult to calculate, but the returns in a more satisfied and contented citizenship are not hard to determine.

The purpose for which trees are planted in the region often prevents the selection of a favorable planting site. Farm buildings and yards are fixed, and consequently the trees must be planted on a more or less fixed site if they are to serve a useful purpose. Oftentimes this site is much higher than the surrounding farm land and

may be of a soil type decidedly unfavorable for all kinds of plant growth. The site must be prepared by breaking the sod and keeping the land free of all growth for one or more years previous to planting the trees. Unless a moisture reserve has been stored in the soil previous to planting, there is very little chance of successfully establishing the stand.

The Plains forester has few or no indices to guide him in his selection of species and only a very narrow list of species from which to make his choice. Within this range of species, he must use the trial and error method to find the ones best suited to any particular site.

The Plains forester grows in his nursery principally hardwood stock as 1 or 2-0 seedlings. He is not interested in growing tall stock, but endeavors to grow diameter and a high root to top ratio. To encourage this type of growth he uses little or no irrigation water. All stock grown by the Mandan station is produced strictly under dryland conditions, and the results when it is planted on the farm under adverse conditions have more than justified the difficulties encountered in growing stock without irrigation as compared with the more easy and sure way by the ues of water.

Planting methods used in forested regions are not suited to the Plains. The hardwood stock, if it is to succeed, must have a well branched root system which must not be crowded into a narrow opening. Only very rarely can a planting method other than digging a hole be used.

The planting must be cultivated three or four times a season for several years if good growth and survival are to be obtained. The forester must be constantly on the alert to prevent attack by insects and rodents. The trees should be protected at all times from livestock. It is sometimes difficult to convince the farmer of this necessity. During the recent drought years the trees on some farms furnished the only available green browse for the milch cows and calves, and consequently fences were taken down and the trees injured to such an extent that their usefulness was reduced and their life shortened.

The Bureau of Plant Industry through the Northern Great Plains Field Station, Mandan, N. Dak., has been investigating the possibilities of growing trees on the northern Great Plains for the past 25 years. Data have been obtained from investigations at the station and from a large number of farm plantings set out in the region during the past 24 years. Testing plots are maintained on the Mandan station where many native and introduced species have been planted to study hardiness, growth characteristics, and other pertinent factors, such as growth in pure stands, in mixtures, and with different cultural treatments.

All farm plantings are set out under prescribed instructions which include the preparation of the land, the planting plan, planting methods, and cultural requirements after the trees become established. The history of each planting is known from the date of land preparation, or for the duration of those plantings which failed to survive.

The data collected from these plantings have proved beyond questionable doubt that small tree plantings for protection purposes can be successfully established and reasonably well grown on most sites if the land has been properly prepared, if the right class of stock is used, and if certain cultural practices are followed. Studies conducted by the Mandan station for the past 17 years on the grading of nursery stock by diameter classes have consistently proved that the comparatively small "stocky" stock with well branched roots will give better stands than the taller "slim" stock often with poor roots, when both are planted under adverse conditions. It has been extremely difficult to persuade the farmer to accept this kind of stock. His idea is to plant a tree today and sit in its shade tomorrow. Also the system of grading planting stock by commercial nurseries, which is based wholly on height classes with an increase in price for each 6 or 12-inch increase in height, has led him to believe that the tallest stock is best.

The investigational plantings have yielded data on how to space, arrange, and care for trees so that the maximum growth and survival may be maintained; so that wind and snow protection will be afforded the farmstead; and so that self protection will be afforded the trees. It has been found that, owing to the high mortality of coniferous species when planted under limited rainfall and a high evaporation rate, hardwood species must continue to form the major part of each planting. Only in those infrequent years when the evaporation rate is low, for at least the early part of the summer, can coniferous stands be successfully established.

The lower branches of windbreak trees must not be pruned. A dense growth near the ground is necessary to hold snow, prevent entrance of sun and wind, and prevent excessive weed

growth. Tree plantings should not be composed of a large number of rows. The drifted snow which collects within a windbreak is such a vital moisture factor that leeward rows of a wide planting which collect no drifting snow will soon give up the struggle. Studies at Mandan have shown that it is possible for windbreaks, over their entire length and width, to collect drifts of snow which will have a moisture content equaling or exceeding the normal annual precipitation.

Trees on the northern Great Plains are often comparatively shallow rooted, which is caused by absence of sufficient moisture at greater soil depths. The trees, therefore, must rely largely on current moisture.

Studies made over a period of years show that all soil moisture above the wilting point usually is exhausted to a depth of 6 to 8 feet by the middle of the growing season. The moisture content is much the same at the end of the growing season in the same layers with no evidence of the roots tapping available moisture at a lower level. The exhausted moisture is sometimes replenished in the surface layers before the ground becomes frozen for the winter months. Ordinarily, however, the trees go into the winter without available moisture in the soil zones occupied by feeding roots. Coniferous species, during their early years, may be an exception to this statement, as the data show such species make lower demands upon available moisture than do hardwood species of like age. Moreover, coniferous species do not exhaust the soil moisture to as great a depth as do hardwood species.

By the beginning of the following growing season, the soil moisture in the previously exhausted zones will have been restored only in those parts of the planting which collect considerable drifting snow. In the area occupied by trees collecting little or no drifting snow, only very rarely will the soil moisture in the previously exhausted zones be replenished to the field carrying capacity. Ordinarily, in such areas the amount of water replenished in the soil during the dormant period becomes less in each succeeding year unless abnormal rainfall is received in the early spring. Trees, therefore, cannot continue to thrive indefinitely unless sufficient moisture is received at some period of each year to restore exhausted moisture to the field carrying capacity of that soil. The most practical and oftentimes the only possible method of restoration is by trapping drifting snow.

The importance of soil texture in absorbing heavy rainfall and in the amount of water released for the use of plants is well known to every forester. As previously mentioned, it is seldom possible to select the most favorable planting sites on the northern Great Plains if the trees are to serve a useful purpose. The heavy clays with their slow absorbent powers, which retain a high percentage of the moisture against the pull of plants and which often have an impervious zone of lime enrichment near the surface, have to be planted as frequently as the usually more favorable sands and loams.

It does not always follow that the most favorable tree growth will be found on the lighter types of soil. Within a given planting of trees several years of age, changes in soil type caused by the trees growing thereon usually can be determined. Comparative studies of these changes in soil type have been made by extracting cores of soil with a soil tube. The cores were placed in glass tubes immediately after collection and represent cross sections of the soil in place. These studies have not been carried on sufficiently long to warrant definite statements at this time, but the differences found in soil texture and structure are sufficient to explain the differences found in the growth and survival of the trees. This particular problem offers a very fertile field for future study on the northern Great Plains.

It has been found extremely difficult to secure forest conditions within a belt of deciduous species. After the leaves drop in the fall, very few plantings are sufficiently tight to prevent entrance of wind. Occasionally a farm planting is found which has ideal conditions on the floor of the planting. Such plantings, however, must be considered the exception rather than the rule.

Coniferous species establish forest conditions very readily in reasonably full stands.

Reproduction is very rarely found in farm plantings on the northern Great Plains. Tree plantings which develop forest conditions on the ground are usually the ones which have some reproduction present. This reproduction is usually confined to those species making up the planting, but occasionally some reproduction of species foreign to the planting is found. Siberian pea-tree, boxelder, ash, and chokecherry are the most promising species for producing an understory by natural regeneration. Chokecherry and redcedar often reproduce from seed carried in by birds.

On the northern Great Plains, species cannot be expected to live to the ages or to attain the growth they do in more favorable parts of the country. If they are to survive, the trees must follow the growth habits of the short grass prairie. A windbreak attaining an average height of 25 feet for its tallest species is considered as having fulfilled its mission for wind and snow protection when planted on the average upland site. On favorable sites, some species have reached heights of 40 to 50 feet.

Survival of trees on the Great Plains is dependent upon many factors. During years of normal rainfall, the percentage of an established stand which will survive at 5, 10, 15, or 20 years of age can be foretold with reasonable accuracy. The severe droughts of the past five years have made that measuring stick obsolete. Some species which heretofore had made a remarkably good showing in the matter of drought resistance have suffered greatly, and some species previously considered as "borderline" species have survived in an unexpected manner. Examples of the former species are green ash and burr oak in both native and planted stands. Boxelder is an example of the latter species.

Under normal conditions of rainfall and insect epidemics the tree planter on the upland prairie site may expect a period of 20 to 25 years of useful life from his trees. Under subnormal moisture conditions and abnormal insect infestations, as experienced the past five years, the period may be reduced to 5 or 10 years, or the stand may never become well established. Whatever the period of useful life may be, the tree planter must keep in mind that a tree planting on the northern Great Plains is another farm crop and must be treated as such. It must be periodically renewed, not by replacing a tree as it dies out, but by making provision for an entirely new planting adjacent to or near the former one when that planting commences to show signs of decay. The forester or tree planter who is prepared to look upon tree planting from this angle will find his labors rewarded with success, not measurable perhaps in dollars and cents, but measurable in the improvement of conditions around the home and in making his community a better place in which to live.

THE MEANING OF THE LAKE STATES FOREST SURVEY

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THE Forest Survey statistics for the Lake States are discouraging or encouraging according to whether you look at the shortcomings and undesirable trends or at the potentialities under better management.

Let us examine first the undesirable features. Compared with the original forests of the region, or judged by a standard of well-managed second growth, the present forest areas are in very poor condition.

The distribution of size classes in the Lake States is not satisfactory for sustained-yield management. We find a small area of old-growth timber, and relatively little second growth of saw timber or cordwood size. Two-thirds of the entire forest area is deforested or is just restocking (Table 1). This means that with the exhaustion of mature timber, operations will have to cease for a time or be conducted in stands not yet ripe for cutting.

Only 3½ million acres, or 6½ percent, of the forest area of the Lake States now support old-growth saw-timber stands, a proportion smaller than that found in any other important timber region of the United States. In the Southern States, 15 percent of the forest area bears old-growth timber, and in the Pacific Northwest the proportion is 45 percent.

With such distribution of size classes, the average volume per acre is naturally small. The survey has shown a total of 57 billion board feet of saw timber—a little more than 1,000 board feet per acre on the average. For comparison, the Southern States' forests average close to 2,000 board feet per acre, and those of the Pacific Northwest more than 20,000 board feet. The Lake States have only about 10 percent as much saw timber as the Pacific Northwest, and only 15 percent as much as the South. Even this relatively small volume is not all available for

commercial use. Approximately one-third of it is too scattered, too small, too inaccessible, or otherwise unavailable for immediate use.

The rate of depletion, both from logging and fire, has decreased greatly in recent years. We find the present Lake States drain 2.4 billion board feet annually—only one-fourth as much as in the Pacific Northwest and one-tenth that in the South. But even this reduced rate of cutting and loss is more than the present forests can support permanently. With continued clear-cutting a considerable number of large sawmills will have to close in the next 5 to 10 years and the majority of them will be out of accessible loggable timber in 20 years. Pulp mills and miscellaneous forest industries will be affected correspondingly.

With the disappearance of dense mature forests there is a tendency to continue operations in the young second-growth stands. Farmer logging or small contract jobs replace the regular logging camps, and the logs or bolts are hauled to central points by rail and truck, or are cut by small local plants. In so far as these jobs remove the inferior trees left in the first operation or are conducted as thinnings or improvement cutting, they are advantageous. When, as is usually the case, they remove the young thrifty dominant trees which are just reaching minimum merchantable size, they are a genuine menace.

Not only in the distribution of size classes, but in density and composition, the present forests fall short of a desirable standard. The Lake States have 11 million acres of deforested land, which means land supporting fewer than 100 trees of commercial species per acre. Another 10 million acres is poorly stocked with reproduction. As compared with the 40 percent of poor to nonrestocking areas in the Lake States, the Pacific Northwest has only 17 percent and the South only 14 percent of the forest area in this class.

Of the second-growth stands of all sizes—saw timber, cordwood, and reproduction—45 percent is dominated by aspen or scrub forest and 26 percent by other hardwood types. Only 8 percent of the second-growth is pine and four-fifths of that is jack pine. Twenty-one percent is made up of balsam fir, spruce, tamarack, and cedar.

Let us now examine some of the more favorable aspects shown by the Survey.

The region still has a large area available for timber production. A total of 55.6 million acres, or 45 percent of the gross area, has been classified as forest land. This is a much larger porportion of forest than is found in Germany, Norway, or France; and not much less than in Sweden or Finland. The Lake States with 4.1 acres per capita have 7 or 8 times as much forest land per capita as France or Germany.

When one considers how recently and how completely the forest lands of the Lake States have been cutover, it is not surprising that two-fifths of the area is still inadequately stocked. It is a matter of only 50 years since the pine saw mills were at peak production in the Lake States. Only 45 years have passed since the Hinckley fires; 21 years since the Cloquet fires. Considering the logging history of the region, we find it somewhat surprising to have 31 million acres of second growth of any kind.

The volume in terms of marketable timber is small, yet there is an appreciable volume of wood on the land. On the entire 57 million acres we find an average of 464 cubic feet per acre. Exclusive of the deforested land, the average is 566 cubic feet per acre. With approximately the same forest area, Sweden has an average of 874

TABLE 1.—AREA, VOLUME, AND GROWTH, BY TIMBER-STAND SIZE CLASSES IN THE LAKE STATES

Size class of stand	Area of class		Average present stand per acre		Average annual growth per acre	
	M acres	*Percent*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*	*Cu. ft.*
Old-growth saw timber	3,586	6.5	8,985	2,650	63	12
Second-growth saw timber	3,538	6.3	3,937	1,629	129	22
Cordwood	10,837	19.5	671	688	69	36
Restocking	26,430	47.5	111	82	9	16
Deforested	11,244	20.2	105	61	6	3
Total	55,635	100.0	1,036	464	31	18

cubic feet per acre and Finland 775 cubic feet. Norway has only 604 cubic feet per acre on the average, not much more than in the Lake States.

Considerably more volume is being added through growth in the Lake States than previous estimates have shown. Relatively little of this growth is on trees of merchantable size or quality, consequently it has little bearing upon the immediate prospects for forest industries. However, it does mean a great deal for the future. Average annual growth for the region is 18 cubic feet per acre. Exclusive of deforested land, the average is 21 cubic feet. For comparison, current growth in Sweden is 29 cubic feet, in Finland 25 cubic feet, in Norway 20. The South and Pacific Northwest average about 32 cubic feet per acre.

If the current growth in the Lake States could be allowed to accumulate for 20 years, we would have a growing stock practically equal to that of Sweden. In 40 years, even if all old-growth and other mature timber were cut in the meantime, we should have a fairly well-stocked and well-balanced forest.

Forty years should also bring about considerable change in the composition of the second-growth forests. No adequate basis is available for expressing the trend quantitatively, but there can be little doubt, after examining the Survey stand tables, that in the absence of fire and premature logging many areas now classified as aspen will evolve into pine, spruce-balsam, or hardwood type in 40 years or less. Some jack pine stands are tending toward the red pine type. No doubt large areas of brush and grass, if protected, will restock at least to aspen.

If, therefore, logging could be confined to mature and overmature stands for 40 years, while the second growth had a chance to develop, the Lake States forests should be far on the way toward recovery. Calculations indicate that such forests would produce, on a sustained-yield basis, more than twice as much saw timber as at present.

During the next 40 years, however, the available merchantable timber would have to be carefully rationed, and selective logging would have to be practiced in any stands which would permit it. Rough calculations indicate a possible annual cut of 1.6 billion board feet or approximately two-thirds of the present drain.

Does this mean that the Lake States must voluntarily sacrifice one-third of its forest industries to be able to practice forestry? Not necessarily. In the first place, it is not a question of sacrifice. If present clear-cutting practices continue, more than one-half of the important producing mills will have to close within a few years anyway, and it is doubtful if the average yield of the region can be maintained at a level as high as 1.6 billion feet for the next 40 years with destructive cutting practices.

More than one-eighth of the present saw-timber depletion is caused by fire, insects, and disease. Another eighth is caused by cutting for fuel, fence posts, distillation wood and, similar products for which cull trees and topwood should suffice. No doubt some of this quarter of the total volume now wasted or diverted to minor uses could be saved for manufacture into more valuable products.

Opportunities still exist for developing new industries or for expanding existing industries which make use of inferior woods. For every thousand board feet of merchantable sawlogs available for cutting during the next 20 years, there are 3 cords of inferior timber in the form of cull trees, cull logs, tops, and limbs. Any developments in manufacturing or in logging which will permit greater use of this material will add just that much to the life of forest industries in the Lake States.

There are, of course, many practical difficulties in the way of reorganizing the whole system of lumbering in the Lake States. However, if foresters know that the possibilities exist, and know what they want to accomplish, advantage can be taken of all opportunities to move in that direction. I believe that the Survey data show there are still sufficient resources to reestablish a productive forest within 40 years and not at prohibitive cost.

To sum up briefly:

The Lake States forests are in a rather badly depleted condition as regards commercial saw timber. Relatively little old growth remains and that is being depleted at a rather rapid rate. On the other hand, in the short time since the region was cutover, nature has done a fairly good job of restoring the forest cover. Growth is already sufficiently good to promise development of a productive forest resource within 40 years if proper cutting methods are adopted immediately.

ACCOMPLISHMENTS AND PROBABLE FUTURE OF PRIVATE FORESTRY IN THE LAKE STATES

By GEORGE BANZHAF
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IT might be well to state in the beginning that I do not intend to treat my subject from a statistical standpoint and that it is my further intention to be brief. My remarks apply largely to Wisconsin and Michigan as I am not familiar with Minnesota, and they reflect the attitude of a pulpwood and not a hardwood operator.

The accomplishments of private forestry in the Lake States have not thus far been impressive and its future is difficult to forecast. Few of us are willing confidently to predict the future of anything in these days of change and unrest. We have become economic agnostics—we just don't know. That does not mean that we have become defeatists—far from it. As a matter of fact, there is nothing in which I am more deeply interested than in the development of private—or shall we say commercial?—forestry. This interest is, of course, natural because commercial forestry is my bread and butter, but an even deeper interest springs from the fact that I have a profound belief in individualism and in the solution of social problems through the operation of the profit system.

I use the term "social problem" because a great many foresters treat forestry from the viewpoint of the professional social worker. They think of the forest as a creator of employment for the small backwoods farmer, as a preventive against ghost towns, erosion and floods (all of which are, of course, important), but they do not, without a conscious effort, regard the forest in a dollar sense—as an income producing property. This is not at all strange, because foresters have been trained as evangelists and as apostles of a faith. Indeed, I cannot help but feel that many foresters' interest in private forestry is much the same as the interest of a missionary group in a progress report covering work among the heathen. The forester wishes to convert the lumberman and forest products producer, but I doubt whether many foresters have a great desire to become forest operators themselves. The establishment of private forestry is regarded much as was the ancient search for the Holy Grail—"hopeless but glorious."

It is my belief that private forestry will not be widely established until foresters as a profession become truly interested in dollar forestry. This means that our forestry schools must so educate young men that their technical forestry training may be supplemented by a knowledge of business problems and methods, and that they may learn to think in terms of cost. They must become dollar minded. For, after all, private forestry is no different from any other private venture—a product must be sold for more than it cost to produce. It would be a fine thing if such a training produced in the forestry school graduate a desire ultimately to own and operate his own forest—for that can be done—but in any event he would carry a point of view to his private employer that would make him valuable, assuming, of course, that he is intelligent and is willing to work. The dollar point of view in our young foresters will do much for private forestry because private forestry, if it is to justify itself, must be able to pay its way and show a profit—the profit may well be expressed partly in social benefits, but it must also be in cash. Foresters like to think of themselves as professional men, yet a man who is practicing commercial forestry is not practicing a profession, he is engaged in commerce. Someone has said that "forestry is a noble profession, but a hell of a business," yet I am not prepared to admit that such is the case. Any business is difficult and all have problems—some of them so serious as to appear insurmountable.

The subject of dollars naturally brings us to the subject of silviculture, because silviculture in a commercial forest operation is inevitably pegged to the dollar. Foresters have for many years discussed minimum silvicultural requirements as they applied to regional forest types, yet silviculture is not a regional matter. It is essentially and peculiarly a local matter. Silviculture in a commercial forest operation may be governed partly by the composition of the forest, by the site, and by future objectives, but it is governed primarily by a number of purely practical considerations such as costs and markets. A commercial forester can cut only what he can profitably sell. This is the reason that so many foresters have never been very enthusiastic about the possibilities of commercial forestry. They feel that

financial and marketing considerations become such strong limiting factors that forestry in a true sense becomes impossible. That financing and merchandising do operate as limiting factors cannot be denied. It is also probably true that under these limitations forestry, in terms of classical silviculture, becomes impossible. If, however, forestry is defined more broadly as the permanent dedication of an area of land to the production of forest products, then commercial forestry is not only possible, but profitably possible. The silviculture of a commercial forest operation may sometimes, of necessity, be crude. It may evolve into a sort of species selection based entirely upon market requirements. In fact, it may not differ much from ordinary logging practice. The forester in charge may be satisfied if he leaves a thrifty, growing, young forest behind him. There probably is no doubt, however, that silviculture can be much improved on commercial operations without overstepping the limit set by cost.

Foresters of an earlier period woefully underestimated the natural regenerative power of the North American forest. They certainly did so in so far as the swamp and hardwood forests of the Lake States are concerned. When I was a young graduate just out of college, old-school lumbermen used to tell me that if fire were kept out the forest would come back. That seemed very naive to me at the time, but it is certainly proving to be true. It is, of course, obvious that a crude silviculture of this sort does not make any effort to regulate the composition of the future forest resulting from these tactics. If the forest is hardwood there may be a heavy percentage of undesirable beech in the new forest. If the forest is swamp, the new crop may run heavily to balsam and cedar to the exclusion of more valuable spruce. The young forest may not be entirely satisfactory from the standpoint of composition, but if it is low in quality it is also low in cost. It has planted itself naturally and the original investment in the property should have been liquidated when the desirable mature timber was harvested. Hence, the cost of the young forest, when its turn comes to be cut, is represented chiefly by accrued taxes on a forest area officially classed as cutover land. These taxes, under existing tax conditions in the Lake States, are low.

It is possible to build up a very substantial area of producing forest without the initial investment of large sums of money. The procedure which can be followed can best be demonstrated by the use of an inverted triangle subdivided by several equidistant lines parallel to the base.

The area above the upper horizontal line indicates the area of virgin timberland owned by the average operating timber company. This virgin timber area represents a heavy capital investment against which interest and taxes must be charged. Worst of all, the property produces no income except as it is liquidated. The timber company then engages in a race against interest and taxes, and each year its area of uncut timber is a little smaller, as indicated by the horizontal lines, until it reaches the apex of the triangle when it is out of business unless it begins the entire procedure over again.

The commercial forester can reverse the procedure by buying a small forest area at a price representing the fair value of the present merchantable stand. He cuts it at once, with due regard to leaving a young forest behind, and if his operation is well conducted and the products well sold his investment has been liquidated and he has a modest operating profit left. The remaining young forest is held for the future, but there is no investment in the property. This can be repeated until, working up from the base of the triangle, the forester has a steadily increasing area of growing forest which again is represented by the horizontal lines; but which represent no cost outside of accrued taxes. This procedure is particularly well adopted to the northern swamp where one can work on a twenty-year period of return.

All this, of course, has nothing to do with the problem of placing a large acreage of virgin timber under management. The young forest, resulting from the crude silviculture that I have mentioned, may not be a highly desirable forest from the standpoint of composition according to present standards. If that is the case, won't it present a marketing problem when it is cut? Perhaps, although I am inclined to doubt it. Long range forecasting has fallen somewhat into disrepute. We don't know today what will be desirable species 25 years from now. If foresters had been asked this question early in this century they would undoubtedly have picked white pine. Had the Lake States pineries been managed so as to produce a steady, large volume supply of white pine their choice would have been correct. As it stands today, however, there are not

enough white pine logs produced in Wisconsin and Michigan to maintain a steady market for them. The theory held by many early foresters that a scarcity of white pine would produce sky-high prices has not been justified. Foresters are able to do much long range planning. Flexibility has become the watchword of our age. Long rotations for the production of sawlogs to meet the requirements of markets of the far off future will, I am afraid, be out of the picture. The private commercial forester is thinking in terms of short rotation and of the production of wood fibre instead of logs. Our forests may not be of ideal composition, but they are growing, and I feel sure that there will be a market for the product when harvest time comes.

During the past ten years we have already begun to use such species as white birch for pulpwood which was never previously considered for that purpose. The paper industry has a tremendous investment in the Lake States and I am confident that it will find a use for the raw material growing in its own back yard if it continues to be produced in sufficient quantity so as to justify attention as a major, and convenient, source of supply. With the greatly improved fire protection that the states are giving us, this appears to be a probability. Of course, many mills are now buying large quantities of pulpwood from Canada. This is partly due to the fact that the Lake States could not alone supply the pulpwood requirements of Lake States mills; partly because Canadian spruce is available in large quantities and is desirable because of its greater density; and partly because labor conditions in Canada are favorable to large-scale woods operations. It has been assumed that this trend to Canada will gain in momentum to the point where American producers will no longer be able to find a market for their products. There is an old financial axiom that reads "Don't ride a trend too far," and that applies in this case. Lake States forests will, I am sure, continue to be an important supplier to the mills of the territory.

Now let us see what specific things have been accomplished in the field of private forestry in Wisconsin and Michigan. In a report issued in 1938, the U. S. Forest Service gave the following broad general statistics concerning the estimated area of privately owned commercial forest lands (exclusive of farms) under management in the Lake States.

Under intensive sustained yield management	72,000 acres
Under extensive sustained yield management	28,000 acres
Under extensive management, but not sustained yield	631,000 acres
Total under some type of management	730,000 acres

In view of the fact that I am not including Minnesota in my discussion, I might say that only 35,000 acres in the above total are in Minnesota.

There are several private forestry projects that are deserving of particular attention. R. B. Goodman, president of the Goodman Lumber Company of Marinette, Wis., has been a leader in the movement and his company has about 65,000 acres under forest management, on which the first cycle will be completed in 1942.

An outstanding private reforestation development is being carried on by the Nekoosa-Edwards Paper Company of Port Edwards, Wis., under the very able direction of their forester, George Kilp. This company has 26,000 acres in plantations and the lands are all in the general neighborhood of the mill. About 90 percent of the area is in jack pine with a rotation tentatively established at 35 years. All planting stock comes from the company's own nurseries. It is my understanding that the company intends also to plant poplar on the better clay soils. The objective of the entire project is to provide a supply of raw materials within easy trucking distance of the mill. It is the intention of the company ultimately to have sufficient growing timber so that it will not be entirely dependent upon the open market for its supplies of pulpwood. There is no intention on the part of the company to attempt to produce its entire requirements. A substantial acreage of its own will, however, act as a governor in so far as pulpwood prices are concerned.

In the Upper Peninsula of Michigan the Patten Timber Company of Amasa has been working for some years on a program of putting its lands under management. The company's forester, Bruce Buell, has charge of the entire program including both planning and operating. To date 15,750 acres have been logged selectively. In addition, the Patten Timber Company has under management 12,450 acres of highland reproduction and 9,800 acres of swamp reproduction. Mr. Buell informs me that the highland reproduction

consists of hardwood lands which were cut over prior to 1930 and areas of highland spruce, balsam, and poplar not large enough to classify as timber. The swamp reproduction covers lands cut over on the company's system, which is based on leaving all trees having less than two sticks (pulpwood or posts). In some cases the swamp reproduction resulted from old logging, or from natural deterioration of old stands. I understand that the company is entirely satisfied with results and that it has no intention of changing its policy.

One of the largest private timber owners in the Upper Peninsula is the Ford Motor Company. It does not have a definitely established forest policy for all its lands, but it is attempting to cut selectively on the lands immediately tributary to its model sawmill community at Alberta, Mich. The mill is a small one, cutting only about three million feet of lumber per year, which is trucked green for finishing to the large mill which Ford operates at L'Anse approximately eleven miles away. It is my understanding that there is no intensive plan of management in effect and that the marking is done on a basis of what is required to leave a good growing forest and an adequate crown cover. I might add that the result appears to be very satisfactory.

In addition to the foregoing outstanding examples of large scale forest management, there are several corporate and individual producers of forest products (my own firm among them) who are considering their holdings as a permanent forest, operated under a crude silviculture, and who rely upon the vigorous natural regeneration of the forest to give them a second crop. One man, who was brought up as a practical woodsman and who is in no sense a technical man, has told me that he believes that he can handle his existing acreage of swamp forest so as to keep himself and his sons permanently in the forest products business. The operations of men of this sort are not spectacular, but they seem to me to be very significant.

We must, of course, recognize that the future of private forestry is inevitably dependent to a very considerable degree upon the attitude of the state and federal governments. Although I believe in so-called "rugged individualism" no one can contend that individualism should relieve one entirely of obligations to society as a whole. The forest is a natural resource and the public very properly has a vested interest in it. I am inclined to think, therefore, that ultimately the state and federal governments will exercise some sort of regulatory control over private cuttings. Whether that will be a wholesome, or a hindering, influence remains to be seen. Regulation by a public agency can become tyrannical, petty, crippling. It can be used to build up a bureaucracy for political ends and as an instrument to force large scale public ownerships. On the other hand, if administered according to the standards of fairness and integrity that have been a tradition among public foresters for so many years, it should work out very well. Any forest regulatory agency, however, must be realistic in outlook and must thoroughly understand the business that it is regulating. It must be tolerant and sympathetic and its administration must be decentralized. The regulating officer must be given a considerable discretionary power in his district. He must be the friend of the operators, something after the fashion of the neighborhood policeman on the beat. Business men play a hard game in which they must of necessity develop a strong acquisitive interest. If they do not, they cannot survive. They need a restraining hand, perhaps, but the restraint must be exercised with a sympathetic understanding of the extremely difficult problems that the operator faces. A regulatory agency (assuming that we are to continue as a capitalistic society) must remember that private initiative is the producer of wealth that pays the taxes. The golden goose may be controlled, but he must not be killed.

In the last analysis the future of private forestry does not rest so much with the timber owners as with the foresters themselves. The forestry profession is a real force in the United States and private forestry will be what you make it. An academic interest is not enough. The profession individually and collectively must take a realistic interest in the possibilities of a movement in which, at present, it only half believes. Forest thought in the United States is moving in a cycle. The early lumberman thought only of dollars. Then came the foresters who thought only in terms of ideals. Cannot the modern forester take something from both schools of thought? A combination of dollars and ideals might produce something of real value. I think it is worth considering.

TUESDAY AFTERNOON SESSION, JUNE 20, 1939

SUBJECT: FORESTRY ACCOMPLISHMENTS IN THE LAKE STATES

Chairman: Henry Schmitz

THE VIEWPOINT OF THE LUMBERMAN ON SELECTIVE LOGGING

BY O. T. SWAN

Northern Hemlock and Hardwood Manufacturers Association

THIS paper summarizes interviews or letters giving the thoughts of thirty northern Michigan and Wisconsin timberland owners and sawmill men. The object of the inquiry was to show what obstacles face the operator when he endeavors to apply the principles involved in sustained yield or selective logging, the advantages which he recognizes, and the conditions which make partial cutting feasible.

Efficient operation forces the operator to cut the merchantable timber rapidly enough to keep the mill in normal production. Good fire protection and proper timber taxation are prime essentials before he can sense the reason in an investment to preserve the remaining timber below merchantable sizes so that it eventually will become merchantable. The investment in the sawmill and the investment in the community determine the character of the forest management. The nonoperating timber owner, whether farmer or small forest owner, does not have the handicap of an expensive conversion plant, and he may find advantages in cutting each year the larger trees and marketing the veneer logs, saw timber, ties, and cordwood.

In this region there are now few large timber holdings. There are several areas where ownerships might conceivably be blocked up into working sustained yield units, but most of the operators have less than ten years' cut, and their small holdings are scattered. In some cases the timber, but not the land, is owned by the operator. Most of the mills buy some logs from other ownership.

Hemlock, maple, birch, basswood, and elm are the chief species. Hemlock creates special difficulties in selective cutting because it apparently is subject to blowdown, disease, insect attacks, and perhaps increased mortality when the forest is opened up. In 1938 over 43 percent of the production of the members of the association was hemlock. On many holdings hemlock may be over half of the cut.

The forest problem in this region has its peculiar characteristics. The bulk of the virgin timber has been cut. Zon estimates there remains about 20 billion feet of hardwood and hemlock in merchantable stands which is being cut at a rate of 950 million feet per year, with an additional loss of 70 million feet through fire, insects, and disease. He estimates that this total drain of one billion feet is at least five times the current growth. He concludes that the industry cannot last more than 15 or 20 years under present trends and practices. However, there are three million acres of second growth that will reach merchantable size in from 40 to 80 years. Zon estimates that the present two million acres of old growth hardwoods, selectively logged, would support an annual cut of 500 million feet, which while reducing the present cut by one-half would almost do away with the waiting period until the second growth comes into the market. Economic Notes No. 10 (1938) of the Lake States Forest Experiment Station gives the saw timber volume in Wisconsin and Michigan at 35 billion feet in trees 13 inches and larger with an additional 10 billion feet in trees from 9 to 13 inches, or a total of 45 billion feet including both merchantable and other scattered timber and secondary species.

For more than twenty-five years the problems connected with deferred cutting have been the subject of discussion at our lumber association meetings. Foresters' reports have been eagerly studied. In 1927 the Northern Hemlock and Hardwood Manufacturers Association published *Selective Logging in the Northern Hardwoods of the Lake States* by Zon and Garver. This is the first lumber association publication on this subject. In 1928 the association published a bulletin by Watson and Banzhaf, which describes selective logging and the selective logging projects of one of the members of the association. Selective logging has been tried by nearly all of the larger operators, but not one feels reasonably certain that his firm will be better off 15 years

from now under selective logging practices.

An operator in northern Michigan with large holdings who is seriously studying the possibilities of selective logging and would like to develop his operation along that line said, "We cannot get good answers to the things we must know before taking what may be a very costly step. How will selective logging affect costs in cutting, road building, hauling, camps, marketing, and overhead? What are the new risks in fire, windfall, and damage to hemlock? What can I be sure of with respect to minimum counterbalancing gains in growth, better yield in logs, and longer use of conversion facilities? We want comparative costs not from small sample areas or text books, but from large scale studies on operations similar to ours."

Another wrote, "I know a little—not any too much—about today's stumpage values, but I am apprehensive about the future. Maybe the chemists will show us how to melt our wood into plastics that will displace lumber, steel, or cement in a thousand uses, but that's another gamble. If our money is free we can get into wood plastic conversion quick enough when it comes."

A man in the second generation of a timber minded family said, "Liquid capital and short-term ventures appeal to me at present. The many rapid changes, and particularly the attempts on the part of the governments to change, regulate, and control economic trends during the past ten years, have done much to discourage any one from planning very far into the future. That overshadows everything else."

One of the operators handling smaller blocks of timber wrote, "Our operations have been on comparatively small stands as we purchase small blocks of timber widely scattered. In our larger block of timber our purchasing arrangements prevent selective cutting. Problems of taxation, fire hazard, quick liquidation and increased capital required, prevent selective logging."

The assumption is often made that it is desirable to apply selective logging to all local timber holdings. But there are still some firms cutting timber from agricultural land in central Wisconsin, land which is quickly taken up when the timber is removed. And there are stands where the proportion of hemlock runs so high that selective logging would not work, and some firms have cutting rights on all or a part of their timber without owning the land with time cutting limits under the contract.

To reach scattered parcels considerable road building is necessary and the greatest amount of stumpage possible must be taken to cover such costs. Mixed ownership brings increasing fire risk and small contractors handling adjoining timber may be careless with fire. By far the larger proportion of operators have a short life, and if they leave a large proportion of their timber they would have to wait 15 or 20 or more years while paying taxes and carrying charges during that period and taking the risks of destruction before making the second cut. These operators believe that public agencies should set up values for residual timber and purchase it at such values.

One operator who is cutting selectively, leaving from 2,000 to 2,500 feet of timber per acre, tells me, "We are greatly disappointed in the unexpected extent of wind damage and slow losses in the stand. We are also disappointed at the reticence and inability of government representatives to arrive at definite figures on the value of residual timber. This is making it difficult to prove to our stockholders and directors that there is any sound reasoning in our present plan. We do not believe that a corporation can afford to pay 4 percent or more for working capital and carry selectively logged lands. Interest, increasing rates of taxation, and increasing costs of governmental regulations cannot be passed on to the consumer because of the dead line made by substitute competition and market values of competing species. Accordingly, the outlook seems to be for declining stumpage values."

An operator who experimented with selective logging some years ago said, "Apparently the age classes were not right and we had to leave large holes in the timber which resulted in blowdowns. In our case the costs were prohibitive. We are satisfied that there are tracts of timber that would admit selective logging to advantage, such as well blocked tracts carrying few species, running heavy to one kind and where the stand does not carry too large a percentage of mature trees. This of course would be under some proper plan of taxation."

"We tried selective logging," another reported, "both in Michigan and Wisconsin. The principle is all right, but we have not enough timber left to warrant leaving a portion and then going back for the balance, for we have only a few years' operation ahead of us. Our plant setup is based upon all the stumpage we had and we would not be able to depreciate the plant if we left one-third of the timber standing. We went

into this matter thoroughly with the U. S. Forest Service in Milwaukee and their answer was that they were not interested in that feature; that that was our problem. Naturally the cost of logging is higher when we only cut a portion of the stand and it is not practical to go back in five or six years and rebuild camps and re-lay tracks."

The paper mill has special problems. Here is a report from one that tried selective logging:

"The foresters came in and spotted the trees which were to be felled, and, of course, picked out the old decrepit ones and from our point of view left the trees with the good sound timber where there might have been some chance of getting a few good boards at our sawmill, and also some good cuts of pulpwood. From the angle of a pulp producer, we like to have the wood from 12 to 14 inches maximum diameter down to 6 inches diameter and, of course, practically all of that was left on the ground.

"From our actual experience on this tract, we found that it cost us $2 per thousand additional to log under this system, when compared with our ordinary method of clear-cutting, and it left a grand fire hazard for the remaining timber which, fortunately, has not as yet burned up.

"We were thoroughly convinced that, with the type of timber we were dealing with and the slow growth, the amount of timber we have left, the quality and the stand per acre, and with the tax situation as it was and still is, the system did not adapt itself to our purpose, especially where we were interested in the timber primarily for pulpwood."

"We have tried to do selective logging in Wisconsin and also in Michigan," states another firm. "We find that after taking out a certain number of trees, which opens the woods, giving air and wind freer play, all the larger trees topple over or break down. Further, it is not possible to leave any hemlock when opening a timber tract, because they all have died, and this in part is true with some of the hardwood. It is only a question of three or four years when we feel nature will deal with others the same that it has with us. Selective logging, which looks good on paper, aside from fire and insects, and taxes, never did work out in our attempts. We have planned to have sufficient cover trees, in order not to have too wide an opening, but whatever we have tried, the outcome has been that we had to go back and pick up the trees that were blown over or deteriorated. Fire in Wisconsin cleaned up approximately a half township some years ago, and we do not consider the fire hazard so much in northern Michigan where it is under better control, but should there be a real dry season, the fire hazard still remains."

Studies made on the Holt area by the Lake States Forest Experiment Station point out that in 1925 all trees over 24 inches d.b.h. were cut and varying proportions of smaller trees were left, so that one-half of the volume was removed and about 6,000 ft. per acre remained. Diameters increased an average of 1.8 inches in 12 years, and at about the same rate for different species, although hemlock and birch grew more slowly. The wood volume increased from 6,184 ft. per acre to 9,384 ft., or an average of 267 ft. per acre per year. It is estimated that the volume of this residual stand increased 50 percent, and its value increased 75 percent, or $1.13 per year. On this basis the foresters estimated that under the reduced taxes under the Wisconsin Forest Crop Law there would still have been an annual increase of 83 cents per acre, or a compound interest rate of 3¼ percent. That is the viewpoint of the forester. Up to that time the mortality rate had been negligible. The owner now reports, "Lately the hemlock has been dying both in the selectively cut areas and elsewhere, but where selectively cut it hardly pays us to log it. We would have been better off if we had realized on all of it fifteen years ago."

Briefly summarized, selective logging is not practicable for pulpwood, hemlock timber, or small or scattered timber blocks, or for sparse stands. For the larger blocks and denser stands of hardwood the inducements of better fire protection and forest taxation are insufficient to offset the uncertainties of future stumpage values, carrying costs of the residual stand, and the risks involved. The change to selective cutting increases the unit logging costs and the curtailment in annual cut increases the overhead costs of producing lumber. These deterrents are presented by the operators who have made sincere efforts to undertake selective cutting.

Problems of Sustained Yield

The practical applications of the problem in the Lake States are well presented in the November 1938 issue of the Journal of Forestry. The author who had been working with competent advisers reports that under the sustained yield plan the present worth of the property capitalized at 4 percent is $1,650,000, while under a plan to cut out in 15 years, the present

value discounted at 4 percent would be $1,100,000 more, or 70 percent greater than on the sustained yield plan. Walley and Bromley, in the discussion of this article in the same issue of the JOURNAL, question whether the long-time risk is as great as the risks involved in quick liquidation; and by an adjustment of factors in finance they show that the sustained yield operation might have a present value as a sound investment greater than that of the operation based on 15-year liquidation. They recognize the tax problem and add, "In spite of this criticism of the evaluating of the income under liquidation, the article points out the difficulties that must be solved in one way or another before sustained yield will be accepted as the most desirable course of action by private industry in this country. If it is possible to increase returns from selective cutting by improving logging methods, reduction of taxes, and other means so as to place the operation on a par with clear-cutting, it seems that the only solution is a reduction of the capital investment in timber. This may require direct participation and partnership by the public in sustained yield through ownership of part of the growing stock, or through regulation of forest practices, or both."

In that published discussion you have what is apparently a fair and balanced recognition of the problems in sustained yield in Wisconsin and Michigan. In dealing with this subject, operators emphasize the special and difficult problems in fire prevention, taxes, and future saw timber values.

Opinion is unanimous that fire protection is now being handled efficiently. Fires stop when they reach the moist, green timber in the Lake States, but when that timber is opened up by partial cutting the drier cover will burn, and if the slash has not been disposed of there will be disasterous results. Partial cutting then involves a greater fire risk, costly slash disposal, or a conversion plant such as a chemical plant to utilize the slash. Chemical plants are expensive, and the market for their products are not stable.

Taxes in Wisconsin and Michigan have risen rapidly for many years up to 1930, and in some localities have continued to increase even during the recent years of low values. Descriptions which were taxed at $48 in 1900 paid $221 in 1910, $754 in 1920, and $1,100 in 1930. This constant increase in the tax on timber of course is forcing liquidation.

The apathy of the public and the demand of local taxing units for the money they can get while the values are present have long put a premium upon quick cutting, and in part have destroyed the effect of the advanced forest tax legislation. The public has not played its part in maintaining local resources.

Next is the apprehension of operators with respect to future values. Until 1907 it was a common maxim in the Lake States that well-bought timber carried itself because values were constantly increasing. The theory of the timber famine encouraged that idea and played no small part in bringing about large operations in the Northwest that have taken values out of Lake States timber. Now the government statistics show a stationary or declining trend in stumpage values. The outlook, in the judgment of many producers, is for increasing production costs, severer competition, production greater that demand, and a danger that research on competitive products may destroy important lumber markets. There are few now who talk about a timber famine. Instead they ask how may we utilize the future products of our forests?

Future damage from insects and storms are factors of risk weighing heavily on deferred cutting. The sawmill at Neopit, Wis., was built to handle timber from 14,000 acres damaged by the blowdown of 1906. Again in 1933 over 10,000,000 feet or more was blown down and salvaged. And still again in 1934 a tornado-like wind struck 6,500 acres on the reservation from which 30,000,000 feet of timber was salvaged. In July 1936 a similar blowdown struck about the same sized area and volume of timber, all of which was salvaged. Over 125 million feet of hemlock has been destroyed by insects on one holding. Of this 40 million feet has been salvaged. These are exceptional cases but they are duplicated frequently on a smaller scale elsewhere.

But in spite of all these difficulties there is constant social pressure upon the industry to maintain the stand through selective cutting operations. The socially minded see the problems that arise as the timber is cleared away. They see that as activity in the woods decreases, there will be less employment for settlers, a smaller market for local farm crops, decreasing tax income from the area, and increasing taxes on remaining values. Federal reports of investigations of specific areas in northern Michigan do not place the blame for these conditions exclusively upon the timberland owners, but recognize that it is the

result of short-sighted public land policies, and that even today the public is not doing its share.

Lumbermen of the Lake States have not been unmindful of the social aspects of different forms of management. There are those who are willing to contribute in no small measure to the maintenance of their communities and to make sacrifices to keep the locality productive and active, but they want to be certain that sacrifices made today to extend the life of the timber will accrue to posterity, and that it will not turn out that posterity would have been better off if the capital had been put into another field.

It must be emphasized that conditions are improving. Advanced fire protection is bringing regrowth which exceeds expectations. The public is becoming more forestry minded and cooperative. Forest tax legislation is perhaps more advanced in Wisconsin than elsewhere, with Michigan attempting to find workable solutions. A large part of this region is being handled under constantly improving forest practice. The minimum requirements of the Lumber Code brought the problem home to many very small operators who had never participated in any organized work before. There are nearly two million acres of county forests in Wisconsin where the state is engaged in the task of forest restoration. Through the Forest Crop Law the state pays a form of tax to local governments, which is helping to re-build these resources. And adjustments are taking place in employment and industrial development. The search for guiding information continues. Splendid cooperative relationships between the lumbermen and federal and state foresters continue to bring about increasing recognition of the mutual obligations of the public and the timber owner.

The state and federal forestry organizations have been active in making fact-finding studies and keeping contacts with lumbermen. They have studied the results of various forms of management and have placed the information before the operators. The broad, factual surveys now available for this region are among the best in the country. The foresters have made progress in getting encouraging tax laws.

Lumbermen know the weak spots in their present methods of operation. They do not know how to select the minimum tree with the low grade log. They recognize that probably many logs are being handled at a loss. Mill scale studies by the U. S. Forest Service will be used if their practical application can be understood by the operator, but in any event these studies bring about a closer approach to logical cutting. Regional Forest Service officials are earnestly seeking a mutually satisfactory basis for the purchase of residual timber. Accordingly, it is reasonable to say that if progress along some lines is disappointing, it must be due to inherent obstacles.

Stabilizing the economic life of a community appeals to those who may have a part in bringing it about. A long-time investment in a natural resource, if the underlying values are sound, may be safer than short-term investments in many other lines as we pass through the financial storms of the future. Large increases in the growing stock, perhaps averaging 4 percent per year, must appeal to any owner who examines the evidence covering growth. In these things are factors of such compelling interest that northern lumbermen have sought to find out how they may operate for longer periods within the framework of forestry practices which will realize these possibilities.

Economic Environment

While foresters generally admit that, broadly speaking, economic environment is not right for selective cutting in the Lake States, they by no means agree that all the adverse arguments of lumbermen are sound; that logging costs are necessarily increased and that a change in methods adapted to selective logging will not hold such costs down; and that the use of trucks in logging has not done much to change the possibilities in effective selective cutting.

Richard Delaney of the Menominee Indian Reservation says, "We have found that there is a strong correlation between wind damage and age of the timber stand, damage increasing in some ratio with age. We have also found that a selectively logged stand suffers proportionally lighter damage than a virgin stand from severe winds and that wind damage in selective stands is negligible in normal winds. This is not alone because proper selection seeks to remove trees which are not wind firm but because the road system developed by a selection operation makes the area accessible for salvage of the material in such limited amount that no attempt would be made to save it under other circumstances. In the long run I doubt if there can be any argument against the fact that areas managed under a selective operation will not only be more resistant to wind damage than natural stands—and even-

aged, managed stands—but that due to uneven aged stocking there will be less chance for a severe set-back in management plans if a tornado should occur. A blowdown in virgin timber entails a volume loss even with successful salvage of at least 10 percent from breakage, twisting, and poor log cutting, whereas a similar blowdown on a selectively logged area entails a negligible amount of such loss."

Even under most favorable conditions quick liquidation apparently is recognized by both lumbermen and foresters as having higher present values and higher immediate profits, but expert foresters claim that present worth under sustained yield is very close to liquidation present worth, and may develop a continuous return on the capital increasing from 3 percent up to 6 percent. They compare this with the current low investment returns under comparable risks. They emphasize that sustained yield is not accompanied by enormous economic and social losses. They emphasize the gains in the growth of the timber capital stock which can be made under careful handling. They recognize that there should be public cooperation in sales and purchases of timberland, in the taxation of forest properties, in making available loans at low interest rates, and in technical studies. They believe that operators are likely to be unduly pessimistic about future values during a declining business cycle and that many apprehensions are unwarranted.

Technical information covering rate of growth, lumber values in trees of different sizes, and costs of operating under different systems is better in quality and volume than ever before.

Need of Public Cooperation

It has been said that no class of men are more difficult to win over to new methods than are the lumbermen. Their self-reliant individualism tends to convince them that only the proved and tested methods are safe. It is difficult to make them understand some of the intricacies of forest finance and the ultimate values involved.

The lumberman is perhaps more inclined to think about the land acquired in the 90's at prices which in 1915, after 20 years of compound interest, still showed a profit; and he thinks of the lumberman who bought stumpage at prevailing prices in 1907 to find that $2 hemlock apparently now stands him $4.60, and in eight or nine years more, according to his method of figuring, will cost him close to $9, while his conversion costs are much greater, although lumber market prices may be no better.

Lake States timber has paid taxes for many years. Through one or more ownerships, most holdings have paid to the public more in taxes than the present sale value of the timber.

There are those who believe that sustained yield or selective cutting should be brought about through public edict. They must assume that the owner can reasonably absorb the costs. I commend to their attention a study of the income tax returns of a number of lumber companies since 1929. The official figures show that, while some made a profit, the combined group in selling 100 million dollars worth of lumber during the past ten years lost 14 million dollars, while giving employment, and paying over five million dollars in taxes. Those figures show that, as long as conditions are such that clear-cutting involves such heavy losses, it is idle to expect that the same companies can absorb the increased cost of selective logging or sustained yield. It shows in a startling way that the problem must be worked out so that the beneficiaries pay the bill in proportion to the gains which they make.

Doubts as to Future Values

The viewpoints of well-informed lumbermen as to the deterrents to selective logging in this region, and the efforts of the Forest Service and the state forestry departments to overcome these practical obstacles by cooperative aids and assistance in the public interest, have been presented; but there remains one further task for these public forestry agencies: the assurance of future commercial values for forest products.

A change from a clear-cutting operation under extensive forestry, but with due regard for forest reproduction, to a selective cutting operation for a continuous or sustained-yield forest management, involves large, immediate capital investments for integrated utilization and for successful operation. It also involves deferred liquidation of forest capital. Silviculturally, such a program is logical, but its economic soundness is dependent on a long-time predetermination of the trends in forest utilization. The lumbermen of this region believe that scientific research in this field of forest utilization has not yet given them the assurance of dependable stumpage values in the long future. This belief indicates the need for successful research in forest utilization followed by successful industrial application. Such

research may establish future values for public and private timber. Furthermore, there is need for research in overcoming the special difficulties connected with deferred cutting, such as methods to reduce logging and slash disposal costs.

Encouraging tax laws are essential if the owner of large stands is to see his way clear to operate under a deferred cutting program. Only through a solution of such problems can the carrying of timber reserves in forests suited to selective cutting be made attractive to capital investment.

For the short-time operator, a quick market for partially cut timber is essential. In the Lake States the time is short. The most effective action which can be taken immediately is that which will put into execution a plan under which there will be an immediate market at fair values for such trees as may be left on the area under plans worked out for the operation by competent foresters. There certainly is some sound basis of purchase values which does not penalize the operator, but which would save the public large amounts in establishing and maintaining public forests.

And finally, since it appears that there is much apprehension about future values, it would be well to initiate a suitable program of economic research to broaden the basic facts and determine whether pessimistic ideas are justified. Steer's study of the rise and fall of stumpage values in comparison with prices of agricultural products and values of other commodities indicates that operators and foresters may be giving too much weight to trends which can be part of the current economic cycle instead of a fundamental long-time drift.

The Northern Hemlock and Hardwood Manufacturers Association will continue to urge that owners go as far as realities permit, while welcoming that public cooperation which will open new avenues to mutually sought ends in social welfare.

FINANCIAL ASPECTS OF FORESTRY IN THE LAKE STATES

By D. M. MATTHEWS
University of Michigan

THE comparative advantages of sustained yield *vs.* liquidation have been discussed at most meetings of foresters for the past three decades. Naturally enough foresters have been primarily interested in the technical and silvicultural side of the problem and, I am afraid, have too often assumed that satisfactory financial results would necessarily follow if sound technical management practices were adopted. We may have been right in this assumption, but the operating timber owner has definitely made it plain that he considers the burden of proof to lie with the foresters. Perhaps the private owner is not to be blamed for refusing to risk his money and time to test the financial soundness of a technical proposition, but unfortunately inexpensive laboratory tests of forest practices are not practicable. Thus foresters and lumbermen worked themselves into a stalemate on this question of sustained yield, with one group unable and the other unwilling to take the necessary steps to prove its financial feasibility.

During the past ten years the financial and economic side of the problem has received more attention from foresters, whereupon lumbermen have become much more interested and a few have been willing to cooperate wholeheartedly. One, R. B. Goodman, has always been interested in this subject, and it was through his cooperation that it was possible for the U. S. Forest Service to prepare one of the best timber management and financial plans that this country has so far produced. I refer to *Timber Management and Financial Plans for the Goodman Working Circle* released through the office of the North Central Region last year. I shall use the basic cost data presented in that report freely in my attempt to discuss from the business standpoint the financial aspects of selective logging and sustained yield in the Lake States.

For illustrative purposes I shall assume a tract of 40,000 acres carrying an average stand of 10 M ft. b.m. of hemlock and hardwood. I shall further assume that a plan of operation is about to be drafted for this area, and thus evade many of the complicated problems which confront the operator who has to convert his operation to sustained yield rather than plan for it at the start.

Two plans will be given consideration, the first a straight liquidating operation taking 20,000 M ft. b.m. per year and the other a selective operation taking approximately 50 percent of the volume through a 20-year period and thus aiming at permanent operation on a 20-year cycle.

Under both plans trucks and tractors rather than rail transportation will be used, and the first step is to plan the lay-out of the interior road transport system. A main-haul road, well graded and drained and surfaced with gravel, will be assumed to run through the center of the area and connect with the mill. This road is estimated to cost $2,500 per mile to construct and to be 13 miles in length (6 miles within the area and 7 miles outside). Where it functions as an interior main-haul road, secondary roads will branch off which will, in turn, be served by spurs to which logs will be skidded by tractors. The proper spacing of these secondary and spur roads is vital to economic operation. The factors governing proper spacing are:

1. The cost of construction of the roads.
2. The volume per acre to be removed.
3. The cost of hauling per M ft. b.m. per hundred feet of distance on spur roads to the secondary roads; and the cost of skidding per M ft. b.m. per hundred feet of distance to the spur roads.

Costs of Road Construction

The cost of road construction per M can be expressed as $\frac{\frac{R}{12.1}}{VS}$ where R is the cost of road construction per mile, 12.1 is the acreage served by a mile of road if roads were spaced 100 feet apart, V is the volume in M feet b.m. per acre to be removed, and S is the spacing of roads in units of 100 feet. The cost of skidding, or of hauling on spur roads, can be expressed as $C\frac{S}{4}$ where C is the cost of skidding or hauling per M ft. b.m. per 100 feet of distance and S is the spacing in units of 100 feet. Minimum cost will be achieved when these two costs are equal or when

$$C\frac{S}{4} = \frac{\frac{R}{12.1}}{VS} \text{ and, solving for } S, \text{ we have}$$

$$S = \sqrt{\frac{\frac{4R}{12.1}}{VC}} \quad \text{or} \quad \sqrt{\frac{.33R}{VC}}$$

The following data as to costs of road construction, hauling, and skidding have been estimated as average for this region:

Secondary roads (plank or light gravel)	$1,200 per mile
Earth spur roads	400 per mile
Cost of hauling on earth roads	0.96¢ per M per 100 feet of round trip distance

Cost of skidding with tractors:

When cutting to a 10 inch limit:	
Fixed per turn cost	$1.13 per M
Variable cost per hundred feet of skidding distance	0.21 per M
When taking 50 percent of volume to an approximate 18 inch diameter limit:	
Fixed per turn cost	$0.80 per M
Variable cost per hundred feet of skidding distance	0.15 per M

With the above cost data available we can now plan the interior road layout.

Spacing of Secondary Roads for a 100 Percent Cut[1]

R, or cost of road per mile	120000 ¢
V, or volume per acre to be removed	10 M
C, or cost of hauling on earth spurs	0.96 ¢

$$\text{Spacing} = \frac{.33R}{VC} \text{ or } \frac{.33 \times 120{,}000}{10 \times .96} = 6{,}400 \text{ feet or } 1.22 \text{ mi}$$

Spacing of Spur Roads for 100 Percent Cut

R, or cost of road per mile	40000 ¢
V, or volume per acre	10 M
C, or cost of skidding	21 ¢

$$\text{Spacing} = \frac{.33 \times 40{,}000}{10 \times 21} \text{ or 800 feet.}$$

The road layout for the liquidating plan is thus determined to be secondary roads spaced approximately every 6,400 feet with earth spurs leading off from them at intervals of 800 feet.

Spacing of Secondary Roads for a 50 Percent Cut

R, or cost of road per mile	120000 ¢
V, or volume per acre to be removed	5 M
C, or cost of hauling on earth spurs	0.96 ¢

$$\text{Spacing} = \sqrt{\frac{.33 \times 120{,}000}{5 \times 0.96}} \text{ or 9,100 feet or 1.72 miles}$$

Spacing of Spur Roads for a 50 Percent Cut

R, or cost of roads per mile	40000 c
V, or volume per acre	5 M
C, or cost of skidding	15 c

[1]In using the formula, we express all costs in cents.

Spacing $= \sqrt{\frac{.33 \times 40{,}000}{5 \times 15}} = 13.2$ hundred feet.

The road layout for the selective plan is thus determined to be secondary roads spaced approximately every 9,100 feet with earth spurs leading off from them at intervals of 1,320 feet.

Costs of Skidding, Interior Road Construction, and Hauling on Earth Spurs

The costs of skidding, interior road construction and hauling on earth spurs can be estimated for the 100 percent cut as under:

Cost of hauling on earth spurs	
$C\frac{S}{4}$ or $0.96¢ \times \frac{64}{4} =$	$0.15 per M
Cost of secondary road construction	0.15 per M
Fixed cost of skidding	1.13 per M
Variable skidding cost	
$C\frac{S}{4}$ or $21c \times \frac{8}{4}$	0.42 per M
Cost of earth spurs	0.42 per M
Total	$2.27

For the 50 percent cut these costs can be estimated as under:

Cost of hauling on earth spurs	
$C\frac{S}{4}$, or $\$0.96c \times \frac{91}{4} =$	$0.22 per M
Cost of secondary road construction =	0.22 per M
Fixed cost of skidding =	0.80 per M
Variable skidding cost,	
$C\frac{S}{4}$, or $15c \times \frac{13.2}{4} =$	0.50 per M
Cost of earth spurs =	0.50 per M
Total	$2.24

Cost of Hauling on Secondary and Main Roads

I am indebted to R. R. Edgar of the Bonifas Lumber Company for the truck-hauling cost figures shown in Table 1.

The average haul on secondary roads will, of course, vary with the shape of the area. In this instance, assuming a fairly well blocked tract, it can be assumed as approximately 3 miles. The average haul on the main road will be approximately 10 miles.

The cost of hauling under the liquidating plan can be estimated as:

3 miles on secondary roads at $0.16	$0.48 per M
10 miles on main road at $0.13	1.30 per M
Total	$1.78 per M

Under the selective plan the cost can be estimated as:

3 miles on secondary roads at $0.14	$0.42 per M
10 miles on main road at $0.11	1.10 per M
Total	$1.52 per M

Loading and Unloading

Mobile jammers or tractors equipped with a loading spar should be used for loading and unloading. No data are available for the operation of these machines in the Lake States. The costs used are therefore for loading trucks with stationary jammers and are probably higher than would be the case were mobile loaders used. They include costs of delay time of trucks and scaling time.

Loading and unloading cost for the liquidating plan	$1.16 per M
Loading and unloading cost for the selective plan	$0.92 per M

Total Cost Summary

Costs appearing herein which have not been previously estimated have been adapted from the Goodman working circle plan previously referred to:

Table 1.—Round-Trip Truck-Hauling Costs on Different Road Types

Road type	Clear cut: Per M per mile	Clear cut: Per M per 100 feet	Partial cut: Per M per mile	Partial cut: Per M per 100 feet	Miles per hour: Empty	Miles per hour: Loaded
	cents	*cents*	*cents*	*cents*	*cents*	*cents*
1. Poor earth spur	50	.96	43	.82	8	2.5
2. Plank	16	.30	14	.27	18	12
3. Gravel woods road for main haul	13	.24	11	.21	25	15
4. Highway	10	.19	8	.15	36	24

WOOD COSTS

	Liquidating plan	Selective plan
Group 1. Current operating variables		
Log making	$2.79 per M	$2.50 per M
Interior roads and skidding	2.27 per M	2.24 per M
Hauling	1.78 per M	1.52 per M
Loading and Unloading	1.16 per M	0.92 per M
Total	$8.00 per M	$7.18 per M
Group 2. Fixed per year		
Camps	$2,500	$2,000
Main Line road:		
Depreciation and maintenance	7,000	
Interest and maintenance		5,700
Supervision and general expense	16,000	16,000
Total	$25,500	$23,700
Cost per M at 100 percent capacity:		
20,000 M at $25,500	$ 1.27	
10,000 M at $23,700		$ 2.37

MILLING AND GENERAL COSTS

Group 1. Pond to green chain	$ 4.94	$ 4.74
Group 2. Green chain to cars (Includes federal and state income taxes and depreciation on mill)	$ 8.59	$ 8.59
Group 3. Fixed per year		
Insurance	$ 3,000	$ 1,700
Administration (Mfg.)	8,000	5,700
General office overhead	43,000	35,000
Maintenance and repairs incurred with time	10,000	10,000
Taxes on timberland	8,000	12,500
Total	$72,000	$64,900
Per M at 100 percent capacity	3.60	6.49

SUMMARY OF FIXED AND VARIABLE COSTS

	Liquidating plan	Selective plan
Fixed cost	$97,500	$88,600
Variable cost		
Woods and mill direct cost	21.53	20.51
Depletion—100 percent of volume	6.50	
Depletion—net of growth (2,000 M ft. b.m. written off annually)		1.30
Total variable cost	$28.03	$21.81

COMPARATIVE FINANCIAL RESULTS

In the financial plan for the Goodman working circle the average value of dry lumber produced under the liquidating plan was estimated at approximately $36 per M and under the selective plan at approximately $40 per M. The following simplified income statements are based on these values:

LIQUIDATING PLAN

Gross annual income—20,000 M at $36		$720,000
Variable costs—20,000 M at $28.03 =	$560,600	
Fixed costs	97,500	
		658,100
Net income at 100 percent capacity		$61,900

SELECTIVE PLAN

Gross annual income—10,000 M at $40		$400,000
Variable costs—10,000 M at $21.81 =	$218,100	
Fixed costs	88,600	
		306,700
Net income at 100 percent capacity		$93,300

These incomes are for the next 20 years in the case of the liquidating operation and for the first 20-year cycle in the selective operation. It would, of course, be possible to estimate incomes in later cycles under the sustained-yield plan and then calculate the present worth of the property under each plan at some acceptable rate of interest. This is the manner in which most financial comparisons have been made hitherto. However, this procedure has the disadvantage of freezing estimated values on one assumed price base at 100 percent capacity operation. The practical operator knows that 100 percent capacity operation for any considerable period is as rare as

an unchanging price base and instinctively distrusts such comparisons.

A more realistic comparison would be one which would take into account the possible variations in business conditions during any period of years and show how the business under each plan would react to these changes. This can be accomplished graphically by the use of a break-even chart or "profit-graph." This is a business tool much used by engineers, and an excellent discussion of its application to the business structure is to be found in *The Mathematics of Management*, by Paul Kellogg of Stevenson and Kellogg.[2]

The preparation of a profit-graph is very simple when the data shown in an ordinary income statement are available. On a set of coordinates dollars are plotted on the vertical axis and percentage of capacity operation on the horizontal axis. Total variable cost as calculated from an income statement then becomes a straight line, beginning at the zero point of both axes and rising at an angle determined by the value of the variable cost per unit. Fixed cost, being a uniform amount, is added to variable cost and the sum plotted as another straight line beginning at the appropriate point of fixed cost on the vertical axis and rising parallel to the variable cost line. This line is therefore the measure of total cost at any given percentage of capacity. The graph is completed by adding a line representing income from sales. This will start, of course, at the zero point of both axes and rise at an angle dependent upon the value of income per unit. In all sound operations the income-from-sales line will intersect the total cost line somewhere within the possible operating volume of the plan under which the business is being conducted.

Graphs for the liquidating plan and for the selective plan appear in Figure 1. The most important point to be noted from these charts is the location of the intersection of the total cost lines and the lines of income-from-sales. This is the point of no profit and no loss and is termed the "break-even volume." Under the liquidating plan we see that this point is where production has fallen to 61 percent of normal capacity or when the operation would be producing 12,200 M ft. b.m. per year. Under the selective plan the profitless point is not reached until production has been restricted to 49 percent of capacity or when the output is 4,900 M ft. b.m. per year. It is quite certain that most business men would accept this comparison as much more definite evidence of the superiority of the selective plan than calculation of the present worth of the property under the two plans at any interest rate high or low.

The profitless point can, of course, be determined for any assumed combination of price and cost, without the aid of the chart, from the formula:

$$\text{Profitless point in percentage of capacity} = \frac{\text{Fixed cost}}{\text{Income—(Volume x Variable cost per unit)}}$$

$$\text{or, } X = \frac{F}{I - Nv}$$

Inserting the values on which the chart is now based, we have for the liquidating plan:

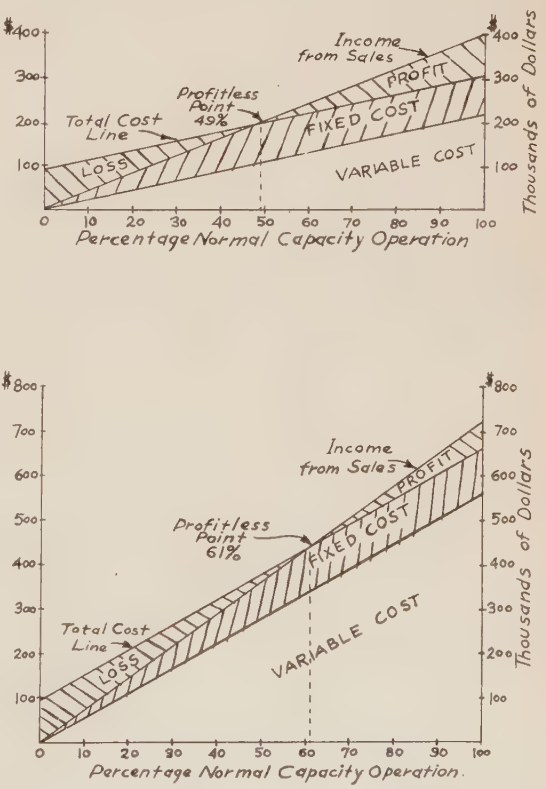

Fig. 1.—Profitgraph for a selective logging and for a liquidating plan.

[2]An address delivered before the Montreal Chapter of the Canadian Society of Cost Accountants and Industrial Engineers on October 15, 1937.

$$X = \frac{97{,}500}{720{,}000 - (20{,}000 \times 28.03)}, \text{ or,}$$

$$\frac{97{,}500}{159{,}400} = .61$$

and for the selective plan:

$$X = \frac{88{,}600}{400{,}000 - (10{,}000 \times 21.81}, \text{ or,}$$

$$\frac{88{,}600}{181{,}900} = .49$$

Another point which can be investigated by means of a formula or read from the chart is the percentage that prices can fall before loss is incurred. We may write our formula:

$$\text{Profitless point} = \frac{\text{Fixed Cost}}{\text{Percent Income} - (\text{Volume} \times \text{Variable Cost per Unit})}$$

or, $X = \frac{F}{\text{Percent I} - Nv}$, and letting X equal unity we have, for the liquidating operation:

$1 = \frac{97{,}500}{\text{Percent } 720{,}000 - 560{,}000}$, and percent $= .913$, which indicates that, with present costs, prices cannot fall more than 8.7 percent before loss is incurred.

For the selective operation our formula will read:

$1 = \frac{88{,}600}{\text{Percent } 400{,}000 - 218{,}100}$, and Percent $= .77$, which indicates that the price level could fall 23 percent under the selective plan before loss would be incurred.

Many other important points can be investigated by means of the break-even point concept, among which may be mentioned:

1. What increase in fixed plant or personnel costs can be incurred to effect a saving in unit variable cost at various percentages of capacity operation?
2. How much can promotional or sales expense be increased or decreased without impairing profits?
3. What prices for an inferior product such as pulpwood will justify diversion of hemlock from the sawmill to the pulp market at various percentages of capacity operation?
4. How much should production be increased in the face of falling prices to maintain profits?
5. How should price and cost differentials as between species and tree sizes affect timber-marking policy?

This is not the place, however, to discuss points such as these. I have, perhaps, not adequately discussed the financial aspects of forestry in the Lake States but rather have emphasized a method of approach to financial problems. My excuse is that I am frankly more interested in a sound approach to a problem than in the details of a specific case. Forestry is a profession which is very closely linked to business. The forester cannot concern himself solely with the technical side of the production of forest crops and ignore the financial and business problems which his technology will engender. Unless he thinks his technology through to the profit and loss account and to the balance sheet, he will never know whether it is economically sound as well as technically adequate. It seems to me a truism that good forestry should be good business.

National Park Conference

THE Third National Park Conference of the American Planning and Civic Association will be held October 8-18 in the Southwest. Headquarters for the meeting October 8 to 10 will be the La Fonda Hotel, Santa Fe, New Mexico. October 11 to 18 delegates to the meeting will make a thousand-mile motor tour of the Southwestern National Parks and Monuments.

Many points of interest will be visited and the Conference promises to be a most enjoyable and instructive one. Complete information regarding the meeting may be obtained from the headquarters office of the American Planning and Civic Association, 901 Union Trust Building, Washington, D. C.

FORESTRY ACCOMPLISHMENTS IN THE INDIAN SERVICE IN THE LAKE STATES

By WILLIAM HERITAGE
Indian Service, U. S. Department of the Interior

IN THE States of Iowa, Minnesota, Wisconsin, and Michigan there are thirty Indian Reservations or former reservations within which some restricted Indian land is still held. There are also a large number of other tracts of land held for the use of Indians under such titles as restricted Indian homesteads, ceded lands, and purchased areas. These holdings range in size from forty-acre tracts, or smaller units, to areas of over 400,000 acres, in the case of the Red Lake Reservation. The total net area of Indian lands in the region is 1,140,000 acres.

The quality of these lands ranges from excellent farmlands to muskeg swamps and barren sand areas. The Indian population in the region as of January 1, 1937, was 30,919 persons representing ten different tribes.

The location and size of the Indian holdings is a considerable factor in the type of forestry practices that the Indian Service is able to follow on the various reservations. Because of the small annual budget for this activity the assistance of all forest protection units near these lands is solicited, and only on six reservations in this region are Indian protection units maintained. On these reservations cooperative agreements are worked out with all other forest protective agencies bordering the units.

The forested area of Indian lands in the region is 991,980 acres having an estimated volume of 953,640,000 feet b.m. of merchantable timber with a value of $3,818,724. On the Menominee Indian Reservation at Neopit, Wis., and on the Red Lake Indian Forest at Redby, Minn., the Indian Service has constructed modern sawmills, with Indian trust funds, and operates them on a commercial basis. The mill at Neopit has operated since 1910; the one at Red Lake, since 1925. The mills furnish labor for the Indians and are of great importance in the lives of these people. At the peak load of logging and milling last January at Neopit 495 persons were employed, and at Red Lake a total of 177 was employed during this same period. The volume of timber cut at Neopit during the fiscal year 1938 was 27,478,000 feet b.m.; and at Red Lake, 6,566,000 feet b.m. The expenditure for labor during the same period at Neopit was $521,931.84, of which $325,000 was paid to Indian employees. At Red Lake during this same period labor expenditures totaled $119,616.44, of which $89,000 was paid to Indians. Substantial profits were made at both mills and during this month over $64,000 was distributed to the Menominee Indians as a per capita payment from the profits of the operations during the fiscal year 1938.

At Neopit the annual cut is limited to 20,000,000 feet b.m. of live timber. During the past five years the hemlock borer has reached an epidemic stage and has killed a large volume of hemlock timber, estimated at not less than 135,000,000 feet b.m. Of this amount it has been possible to salvage some 40,000,000 feet b.m. However, with a decrease during the past ten years in the use of hemlock pulp in Wisconsin the sale of hemlock pulpwood is difficult and at present the salvaging of this material is a major problem. The Bureau of Entomology has had officers at work on this reservation for the past two years trying to work out control methods.

Blowdowns occurred on the Menominee Reservation in 1933, 1934, and 1936, and resulted in the loss of 80,000,000 feet b.m. of timber. The salvaging of this material resulted in a change of logging plans; the logging railroad has been abandoned and all log hauling is now done by motor trucks. Changes in merchandizing practices have also occurred and today motor trucks are used in moving an increasing volume direct to the retail yards.

A forest management plan for the Menominee Reservation was prepared some years ago and additional data have been added at various times. Because the blowdowns and the epidemic of hemlock borer have caused changes in operations, a revised management plan is necessary and will be made as soon as the borer epidemic appears to have reached its climax.

A preliminary forest management plan has been prepared for the Red Lake Indian Forest in Minnesota. While the stand of timber there is quite limited and our present cut is about twice the estimated annual growth, the old stand is so decadent that it is necessary to cut more

than growth during the first cycle, in order to bring the stand to a proper balance. Logging at Red Lake has been changed during the past several years from a sleigh-haul operation to motor trucks. In the past all sawing of lumber was done during the summer, now sawing is done during both winter and summer and labor is made available for a larger number of Indians at a time when such labor is extremely necessary. Within the past year the railroad which served the Red Lake Mill was allowed to cancel its service. This has required adjustment in merchandizing and it will prove difficult to show a profit during the next year or two unless proper roads can be built to handle the products during the spring season or some plan of yard development at rail points can be worked out.

Of the total Indian land area in the region 333,719 acres are allotted to individual Indians in tracts of various sizes, usually about 80 acres. The timbered allotments must be handled so that returns from forest products can be credited to the individual owner. This increases the work that the forester for the Indian Service must do on these lands as compared with the handling of tribal timber because the boundaries of each tract must be established on the ground and the timber cut must be scaled separately for each allotment. Accounts must be set up for each allotment and the funds received for the products credited to that account. Many of the original allottees have died and in such cases the funds are distributed to the allottees' heirs. Many times this requires several entries on the records and much calculating as the various heirs may, and usually do, have various proportional interest in the estate.

Where timber is sold from Indian land other than where sawmills are located, eight percent of the returns are deducted from the Indian's receipts to reimburse the federal government for expenses incidental to handling the sale. On large timber sales where fair prices are received for the products, this amount does reimburse the government for the actual cost, but on all small sales requiring a considerable amount of supervision there is a loss.

General supervision of forestry work, fire protection, and some supervision of timber sales are paid from gratuity funds. This is true of fire suppression except where Indian tribes have large tribal funds in which case they are required to help pay for suppression, or pay all the suppression costs, depending on conditions on the particular reservation.

During the fiscal year 1938 a total of 11,149,000 feet b.m. of timber was cut under contract on Indian land in this region, not including that cut by Indian sawmills. These products returned $55,854 to the individual owners.

The total volume of timber cut from Indian land in the region during the fiscal year 1938 amounted to 57,737,000 feet b.m. with a stumpage value of $205,815. The cut for the present fiscal year ending June 30, 1939, will be somewhat less.

During the past six fiscal years approximately $5,000,000 of E.C.W. and C.C.C. funds have been expended on Indian reservations in this region. Special arrangements are allowed the Indian Service in the handling of these funds and the Army does not assist in the work. Quarters, food, and some clothing are supplied by the Indian Service and all male Indians over 17 years of age who are physically able are eligible for work. The work performed is the same as that done by the regular C.C.C. units.

On the Menominee Reservation over $100,000 of these funds has been expended in trying to eradicate the white pine blister rust first found in these excellent pine stands in 1918.

The C.C.C. work has been of great help in furnishing labor for our Indians at a time when other work could not be had and has advanced the forest improvements on Indian reservations by at least twenty-five years.

Plans for management of the Indians' forest property are being prepared as rapidly as our very limited technically trained force can make them. The amount of work our foresters have to do in order to keep regular work current is large and we have been unable to develop specialists. Assistance from federal and state conservation units as well as the state universities has been requested and received, and this is greatly appreciated. Some progress is being made however and within a short time we will have definite plans for our major units as well as outline plans for the smaller units.

No discussion of an Indian Service employee's work, whether he be a forester, a teacher, or dentist, is complete unless attention is called to the fact that the Indian Service is a human service dealing with all phases of a restricted Indian's life from the cradle until long after the Indian has gone to the grave, and that it is not always possible to adhere strictly to the theoretically correct ideal because of the immediate needs of the Indian owners.

SILVICULTURAL MANAGEMENT OF NORTHERN HARDWOODS

By F. H. EYRE
Lake States Forest Experiment Station

FOR the past decade or more, selective logging has been the catchword of forestry. The term has taken hold and spread like wildfire. There are now many kinds of selective logging—economic selection, area selection, and single-tree selection, not to mention chopper's selection. Much free use has been made of the term. Proponents of sustained yield have grasped at selective logging as the panacea for all ills. It was said to be equally good for all types from pine to hardwood. And to the popular mind anyone practicing selective logging has reached the acme of perfection in forestry. How far from the truth this is!

As elsewhere, selective logging was proposed as a remedy for forestry ills in the Lake States, especially in the northern hardwood section. It still has application. In this region there is a fair-sized remnant of old-growth timber, a great shortage of pole and intermediate classes, and a superabundance of reproduction. The situation with most private holdings is no different from the region as a whole. The aim in forest management should therefore be to practice a type of cutting that will prolong the utilization of the old-growth saw timber as far as possible into the future. The original thought was that selective logging would accomplish this objective.

Although selective logging was based on economics and the principle that large trees are worth more than small ones, a certain amount of silviculture was implied. The term, no doubt, was derived from the selection method of silviculture that has its roots in early European practice, and it seems to have been taken for granted that an improvement in silvicultural practice would inevitably result. But of late, selective logging in the Lake States has come to mean anything and everything. If properly applied it may mean excellent woods practice, but some of the so-called selective logging operations are a far cry from the selection method of silviculture.

Ecologically the northern hardwood forest, sometimes known as the beech-birch, maple or the hardwood-hemlock forest, is a climax type with a preponderance of tolerant species. Virgin hardwoods are uneven-aged, but with the volume concentrated in the larger diameters and, of course, the older trees. Being old and uncared for, northern hardwood stands contain much defect, chiefly in the form of heart rot and butt rot. This commonly amounts to 15 or 20 percent in trees utilized on commercial operations, and may run as high as 30 or more percent of the total stand when unmerchantable trees are included. This is the forest in which selective logging is being attempted.

Since generally it is not difficult to get reproduction, how to get rid of the rot is probably the most important problem with which the silviculturist must contend in cutting selectively a stand of old-growth northern hardwoods. And it is a problem that is not always faced in attempts to apply the selection method, although it is possible of solution by such means. In timber surveys and mill-scale studies all eyes are directed toward utilization, with little thought given to silviculture.

In some commercial operations, 10 or 15 percent commonly, and at times as high as 40 percent, of the stand may be left under a so-called selective logging practice. The decayed, crooked, and otherwise defective or malformed trees that remain after logging bear mute testimony to the lack of any silvicultural objective. Some of this timber may be left in the hope that the government will buy it. In other cases there may be certain recreational values of a speculative nature. But generally it seems to be left because the loggers believe it does not pay to cut.

It is amazing how many of the decisions as to what trees to cut or leave are left to piece cutters who naturally shy away from defective timber when there is no limit to the relatively sound timber they may cut. The standards, too, seem to vary widely from one operation to another. For instance, one company may go strong for long-butting and by so doing throw away select material, while at the same time they push utilization well into the top to a very small diameter. Others do the reverse.

These inferior residual stands are composed of cull trees rotten from top to bottom, small sound trees, and all grades in between. The small trees may amount to something in the future if they do not stand too much in the open. Such trees, especially if birch or basswood, have

a habit of developing stem sprouts which decidedly lower the quality of the future logs. The seriously diseased trees have no future. It would be highly desirable if they were to die immediately after logging, but unfortunately many live and increase in size. They thus take up valuable space, and to the extent that they occupy the soil, the future growth of the forest is reduced.

Residual trees in between the extremes often contain 30 or 40 percent of sound material. Markets may be good enough 15 or 20 years hence to provide for their ready utilization, but from a silvicultural standpoint they should be cut now. Not infrequently such defective trees contain short logs of high-grade veneer quality. If short lengths—say 8 feet—could be utilized, a much better job of cutting could be done on many operations. Is it not possible that careful studies might show that some of this good material in short lengths now going to waste, or worse still, preventing growth of sound trees, could be utilized at a profit? How to secure better utilization of cull trees is therefore a challenge to foresters and operators, and is a problem which if properly solved will go a long way toward getting better silvicultural practice into the woods.

It is an interesting commentary that the old charcoal cuttings in the Upper Peninsula of Michigan are better examples of silviculture than most commercial operations of today. Excellent pole stands have resulted from these early cuttings. It should be pointed out, however, that these operations were absolute clear-cuttings, and the cull trees as well as the sound ones were all made into cordwood. With that kind of utilization, good sanitation cannot be avoided and a satisfactory young stand develops. Clear-cutting of this sort, therefore, would not be such bad silviculture if such points as the continuous production of forest crops and a reasonable period of return for the second cut did not have to be considered.

In applying the selection method to old stands of northern hardwoods, the tree marker faces the problem of finding suitable trees to leave rather than trees to cut, since all appear to have some blemishes. Yet, the marking axe is a potent tool in the hands of a skillful forester, and one who knows hardwoods can do "high grading" or practice good silviculture at will. Selective logging can be good or bad depending on the intention.

With a market for cordwood, mine props, or other small material, as well as for saw timber, the timber marker can really do wonders in cleaning up the woods. Under such conditions selection cutting has splendid possibilities.

For the past 13 years, the Lake States Forest Experiment Station, in cooperation with the Cleveland Cliffs Iron Company, has been carrying on experimental cuttings in hardwoods in the Upper Peninsula of Michigan. Some 15 different individual cuttings have been made, aggregating about 600 acres. In one operation during the past year, what may be considered to be an ideal cutting was carried out on a 60-acre tract. About 35 percent of the basal area was cut; 2,000 feet (net scale) of logs and 19 cords of chemical wood were removed per acre. Although the market for logs was decidedly low—so low that third-grade logs were utilized for chemical wood—a reasonable profit was obtained. The result is a stand relatively free of rot and of much higher average quality than existed before cutting. Selective logging can thus be the means of greatly improving the quality of the residual stand. The extent of improvement depends on how far the operator can or desires to go in providing a future growing stock.

Good selective cuttings such as the one described result in good growth. Ten-year records are available at the Upper Peninsula experimental forest as a basis to judge what can be expected from different degrees of cutting. Heavy cuttings—those which removed 80 to 90 percent of the volume—have accrued at the rate of about 100 board feet per acre per year. Moderate selection cuttings, in which from 40 to 60 percent of the stand was removed, have grown at the rate of 150 to 190 board feet per acre per year; and light cuttings (1/4 to 1/3 of the gross stand cut) have put on from 200 to 250 board feet a year. Since cull trees were utilized, the growth is real rather than fictitious, as would be the case if unmerchantable trees were left. The old principle that it pays to leave a good growing stock is amply demonstrated in these cuttings.

The growth in board feet is, however, only part of the story. Quality growth is a prime consideration. The records show that in the heavy cuttings the growth of necessity was all on small trees, because no large ones were left. In the moderate cuttings it was spread over a greater range in diameters, and in the light

cutting it was confined almost exclusively to large trees.

Mill-scale studies carried on a number of years ago established a definite relationship between diameters of trees and value of the lumber per M feet cut from them. By applying these values to the increment obtained, the growth per acre per year was computed to be worth six times as much for the light cutting as for the heavy cutting. The question of value growth, therefore, should not be overlooked in any plans for selection cutting.

It is fairly apparent, I believe, from the observations presented, that the selection method of silviculture is generally very applicable to the northern hardwoods wherever a reasonably good market is present and when there is an opportunity to dispose of defective material. On the other hand, there is danger that some operations which utilize only sound trees may use the term of "selective logging" as synonymous with good silviculture. Foresters should see to it that they do not. If a goodly amount of silviculture is not injected into selective logging there will be much disappointment when the time comes for a second cut.

TUESDAY EVENING SESSION, JUNE 20, 1939

Toastmaster: Stanley F. Wilson

At the conclusion of the dinner, the toastmaster called on Dr. Clarence F. Korstian, president of the Society of American Foresters, and on Dr. Henry Schmitz, editor-in-chief of the JOURNAL OF FORESTRY. He then introduced Mr. Fred Luening, *Milwaukee Journal*, who delivered the address of the evening.

UNDERTONES IN THE FOREST SYMPHONY

BY FRED W. LUENING
Milwaukee Journal

FORESTRY is in a state of flux. So is humanity and more particularly the American people. Perhaps it would be more accurate to say that the American people are in a state of suspended animation, waiting to attain noble objective in a fairy coach motivated by government.

Most of them have lost all interest in their own two feet.

To gain ground by gripping the rocks of adversity with hobnailed boots no longer is socially scientific. To struggle onward in the sweat of the brow no longer is considered necessary or sensible.

Economic objectives—savings, security in old age, a homestead, a firm family foundation, and a lifetime wholesomely interspersed with both solid toil and simple recreation—no longer are to be achieved by personal endeavors, but instead by gratuities, aides, loans, grants, taxes, and governmental interventions.

All this has a direct and important bearing on your profession.

Once your job was to reconstruct forests for ultimate public or private exploitation. Today your job is to shoo away mosquitoes, cut firewood, chaperon tourists, and tell bedtime stories. At least, you had better realize that that is the conception of your job, and is the expectation of a considerable part of the American public.

Once when you got your clutches on a new purchase area your first aim was to plant trees. Now your first aim better be to clear parking spaces if you would win public approval. Once your second thought was to build fire lanes. Now it better be to provide auto roads. Once your concerns were with, brush clearance, release cuttings, tower construction, and nursery development. Now they better be trail clearance, cabin building, camp fire programs, and a decidedly new form of nursery development that will cradle a pampered public, largely convinced that comforts and conveniences are theirs by right, in the forests as everywhere else.

For the public no longer earns its day in the woods by toil in the smithy or hayfield. It therefore no longer is content with an open glen, a moss covered rock, and a family lunch overrun by ants. It demands of foresters not new trees, but rather removal of old ones that stand in the way of automobiles or trailers. It requires parking areas, rest houses, toilet facilities, fire places, and lecturers. It wants toboggan and ski slides for its winter sports, equipped with mechanical devices to do the work—haul the toboggans and their riders back to the heights

again, without undue effort on their part.

It expects bathing beaches, not unkept as nature made them, but duly sanded with grade A silicon, brought by truck, if necessary, from distant places.

That public is wholly contemptuous of the old portage trails that men once crossed with canoes on their shoulders and deer flies in their ears. It insists, now that we have foresters, that there no longer need be rough portages or deer flies. The portages must be graded, if not paved, and the deer flies exterminated. And if foresters aren't entomologists, they ought to be.

Both you and I have seen forest or park developments—federal, state, or county—equipped with everything from electric lights to hot and cold maid service.

All of us have witnessed the impact of "recreation" upon the forests of these United States and upon the one-time silvicultural and related work of the foresters. Yet I doubt that foresters have caught the significance of this movement. Taken alone, and segregated under the label of "forest recreation," it is a natural, wholesome, and potentially blessed movement. The trouble is that it carries a discordant undertone that is sounding ever more loudly out of all American activities.

If this forest recreational movement meant renewed interest in the primitive wilderness of our forefathers, it would be eminently wholesome.

If it meant that native American instincts, stifled by modern complexities, were emerging from our economic dust bowl for breaths of fresh air, it would be a blessing indeed.

If it meant that our boys and girls, young and old, were going again to the forests to rededicate themselves to the virile lives of the pioneers; to gain the inspirations that once made America the world's most purposeful nation; to understand the majesty of trees, the virtue of patient growth, the virility of nature's eternal struggle, the inexorable workings of the law of the survival of the fittest, it would be upliftingly promising.

Or if it meant, even, comprehension of the trailing arbutus, content to adorn the lowly places; of the endless patience and persistence of the woodland's creations; or of the achievements of humans who once wrested homesteads and security from these wildernesses by willing endeavor, then, indeed, the present American demand for forest recreation would be prophetic of an American renaissance and an American return to attainment, prosperity, and security.

But I am afraid that we cannot construe a movement that demands parking spaces, rest houses, bathing beaches, and easy trails as a pilgrimage to the shrine of the forest gods who guided the magnificent destinies of our forefathers.

A public insistent upon electric lights, running water, refreshment stands, and dance halls hardly is returning to original American purposes and achievements.

I am afraid that the undertone in the forest recreational movement—as in other American activities—has become the dominant note. It proclaims that, in the forests as in the public schools, public buildings, public golf courses, and public economic services, there must be comforts, conveniences and ease; and that these must be provided increasingly and unceasingly by government, which means by the taxable, or wealth-producing minority of the population, that still functions on its own initiative and creates wealth by its own endeavors.

Thereby the present forest recreational movement is largely stripped of its old-time virtues. When men and women went to the forests on their own motive power—packing their own tents and grub, toting their own canoes, fighting their own ways through brush and over down logs, cooking their own meals, and swatting their own mosquitoes—the forests "did things" to them and for them. They taught hard but wholesome lessons. They inspired initiative and courage. They taxed ingenuity, patience, and endurance. And they returned their visitors to civilization with toughened muscles, cleared heads, browned skins, increased energies, and grand new determinations to do things and go places.

Those, who return from our modern forest ventures, return with complaints about the service, and new demands for more public money to provide better comforts at less personal cost and endeavor.

And again I stress the thought that this disposition as it appears in the forests is but incidental to and much less dangerous than a similar disposition demonstrated widely in other fields by many of America's people.

I am not trying to argue that the public funds in reasonable amounts should not be expended within the public forests for recreational purposes. Least of all am I contending that the

public forests should not be wide open to recreation.

The point I rather am trying to make—and the point in which I hope I may interest foresters and others—is that when any individual, or group, or any people, receives too much for too little, the consequences are destructive of personal accomplishment, appreciation, and character.

Many Americans evidently are receiving too much for too little. Many are adopting the philosophy that "the world owes them" not only a living, but agencies to collect it. Many include in this alleged debt due them from society not merely necessities but comforts; and not only comforts, but also luxuries, including woodland outings made smooth under foot and comforting to the belly by public expenditures and the ministrations of public employees, including foresters.

How far we have gone in these directions and how broadly we have accepted this philosophy is better seen in the cities than in the forests. It literally is true, as you all know, that city boys no longer are expected by themselves and on their own initiative to play baseball. They are provided with municipal baseball diamonds and municipally paid recreational directors to "organize" their games for them.

They no longer are expected to, or would dream of, bathing in the old swimming hole. Steam heated pools are provided at public expense instead.

Youthful tennis players no longer would think of grading a vacant lot by their own labor and on their own initiative, as American boys and girls did as a matter of course only a few decades ago. Instead they insist that their papas demand, of their common councils, not only paved municipal tennis courts, but courts that are electrically lighted and adequately enclosed by a thousand dollar fence to save them the effort of chasing balls.

I won't go on with this, though I could cite you statistics on the expansion of municipal recreational activities and expenditures that would make a hard-pressed taxpayer's hair curl. Yet I'm not picking on recreation. I am using that activity merely for illustrative purposes. I am suggesting that in the recreational undertakings, as in many more ominous activities by government, we can find evidences that many Americans are getting too much for too little and that personal initiative and the one-time hardy American ability to cope with difficulties thereby is withered like the seedling by the sun.

Perhaps you cannot square such a contention with the last decade of depression, retrogression, joblessness, poverty, misery, and want. Perhaps you feel that many Americans need more rather than less. They do! Note that I have said, "Many are getting too much for too little." I have tried to imply that merely to give gratuities or gifts solves no economic problems. Let me illustrate.

A well-intentioned boy has a rich uncle. The boy finds it difficult to "get along," so the rich uncle supplies him with spending money. It is a kindly thing for the uncle to do and temporarily it may help the boy. But if, by and by, that boy begins to "lean on" this donation; if, when it comes time to find a job, he doesn't try very hard; if, soon, he manages to induce the uncle to pay him a wage for an artificial job around the house; if, later, he begins to tell the uncle that the wage really doesn't amount to much and that he is "entitled" to additional money for amusements and a sum for savings against old age, and that of course he shouldn't be expected to pay over any part of these gratuities for room or board—well, not one of you here would say that the boy had been helped, or that any remedy for his condition existed except to toss him out and make him stand on his own two feet.

This is the remedy for many people as well as for one person. I make no protest against temporary aides. The good uncle, or the good neighbors, or the good government always have been ready to help after disasters or in periods of temporary hard going, and should continue to do so. But depression, poverty, misery, and want never permanently were licked by gratuities, gifts, loans, artificial jobs, or free facilities. Always, whenever Americans made progress, they did it by rolling up their sleeves, spitting on their hands, and going to work.

Never has there been—not ever is there likely to be—a dearth of work to do. Search your minds and answer fairly: Have you noted any dearth of work to do about your homes, around your neighborhoods, in the gardens you may have, on the farms you know, or in the forests which are your natural stages of activity? Is all work done and gone with nothing left to turn to?

Of course not. Americans always have and always can find work to do. In the past they

tackled endless jobs and thereby worked their ways out of adversity.

Of course, it didn't occur to them that being carpenters they must of necessity find carpentry to do, and must find it in the immediate neighborhood, and under proper conditions, or they couldn't undertake to work at all. No. If carpentry failed them they turned to well drilling, corn hoeing, house painting, gardening, or berry picking.

Neither did they feel that somebody must "give" them a job or there could be no job. They made jobs. They turned to the forests and forced them to yield their timber, or at least their nuts and berries. Or they turned to the soil and forced it to produce needed potatoes or corn. Or they turned to their own little workshops and produced anything from firewood to willow furniture for barter or sale to the neighbors. Or they shaped at the anvil devices of iron or steel and offered these in exchange for bread.

Oh, no! I'm not picturing to you a mere primitive society in the presence of abundant and available natural resources.

Right up to a few years ago men used initiative and ingenuity and thereby made jobs for themselves and for others. They puzzled over kites and winged contraptions and created airplanes. They experimented with faint, strange, and mysterious forces and astounded the world with radio.

But why go farther with any section of the American Association for the Advancement of Science? No group better understands the boundless possibilities for human endeavor, human progress, and human activity than the scientists who have probed them ahead of the rest of us.

In your own field of forestry the garden hoe has been evolutionized into the bulldozer, the wet burlap sack into the modern fire pump, and the block and tackle into the "cat" that drags out stumps or hauls the plows that turn your forest furrows.

You, yourselves, developed many of these appliances and you're going right ahead inventing more of them. And as you convert your inventions into the finished instruments, you help make factory wheels turn, create jobs, and enable more men to draw more paychecks.

To be sure, you and others are estopped by certain influences. One is the present sterility of money which has gathered in great pools of idle capital, called "excess reserves" by the banks. Some ten years ago Americans and their banks had some $43,000,000 of idle reserve funds, the rest of their capital being at work. Today they have $4,120,000,000 of idle reserve funds and mighty little of their capital is at work.

Capitalists, including many little fellows with $1,000 or $2,000 to invest, tell us that *fear* has frozen this capital; that the holders of money, big and little, do not dare put it to work in almost any business for two reasons: first, government is likely to enter the business, competitively, against them—as T.V.A. has entered the public utility business, H.O.L.C. the mortgage loan business, P.W.A. the contracting business, N.H.A. the housing business. And, second, that the public's growing conviction that it is "entitled" to many things "for nothing"—everything from old age savings called pensions, and rent, light, heat, and clothing called relief, to lighted tennis courts in cities and dormitories in the forests in the name of recreation—is fatal to private enterprise.

As more necessities and luxuries are provided "for nothing" or next to nothing, there must be governmental expansions to provide them. As there are governmental expansions there must be private contractions. They follow as the night the day.

Private enterprise cannot extensively give things away. Only government can do that. As it does, demand for privately produced goods offered at a price diminishes. As the demand diminishes, more workers lose jobs, yet thereby become eligible for more free goods.

Then government must collect increasing taxes from decreasing numbers of producers if it wants to continue paying for the goods. It also must increase the volume of goods, which ultimately it can do only by substituting governmental plants for the private institutions that must close down.

Credit, for a time, can be an illusionary substitute for taxation; and "surplus stock"—the goods in warehouses and on shelves—temporarily may supply wants in excess of production. But in the end private enterprise must quit and something else must take its place if this procedure is to continue.

The procedure, of course, is ominously beclouded by the fact that government doesn't, in the beginning, distribute all the goods. It may buy millions of pairs of shoes for the

needy, or thousands of uniforms for C.C.C. boys, as it is now doing, but if it also puts millions of persons on artificial payrolls, the implications are obscured. Those receiving "artificial" government pay buy their own goods and appear to be consumers. Merchants, for a time, seem to benefit by these expenditures as by others. And if, additionally, government hands out unearned annuities, old age pensions, and other gratuities, the true situation becomes even more obscure. This phase of it may be compared to the situation of a dutiful son who runs a grocery store and gives his aged father $50 a month. The old man then spends the fifty in the son's grocery store. The son may ring up the sales and solemnly figure profits on them, but by no ledger-demain can he overcome the fact that he's "out" $50.

And if he gives $50 not only to his aged father, but also to his uncle, his brother, his cousin's wife, and to each of her seven children, his business is going to hell even if this whole relationship spends every nickel in the donor's grocery store.

That's what is happening, and is bound increasingly to happen, to American business as a whole under liberal governmental spending, direct or indirect, through old age security schemes, pensions, A.A.A. checks, W.P.A. payrolls, and the rest. Productive business, under these schemes, is expected first to hand over the various donations and then to thrive when the recipients spend them in the donor's grocery store.

All this is our tendency and perhaps it is our destiny now to swerve from an individualistic and competitive society to a collective one. If so, then recreational facilities—which gave me the theme for this discussion—and many others, will additionally and freely be provided by government. Then the people as a whole, working together for the common good, will create what they need or want, disbursing it freely, without private profit and without the competitive incentive.

But you are foresters. You know a deal about the natural laws that rigidly control all life in the forests. Is it possible that, reflecting on those laws, you may conclude that humanity must for its own endurance subject itself, also, to those laws?

The laws of nature demand effort and struggle by every one of nature's creatures, and men, after all, are among them, regardless of the intricacies of their society and the artificialities of their lives. Those laws demand that even the seeds in the pine cone battle for existence. Rodents attack the cone. The winds carry it into cold waters or rocky crannies. The seeds must resist the cold and the vicissitudes of the bare rock. Birds may eat many of them and a sodden bog may molder the life germs in others. Yet nature demands that the remaining seeds persist, and endure hardships, until a fertile soil appears below them where they may sprout.

Hundreds die, a few sprout, in consequence of adversity even in this first period of vegetative infancy. Yet, having sprouted, the young plants but enter new cycles of struggle. They crowd each other to reach their places in the sun. The weaklings succumb, the persistent alone endure. Thus strength and majesty come at last to the forest, though in the process many individuals—unfit or misfit, enfeebled, incompetent or impotent—perish.

Would you, as foresters, have it otherwise? Can you even imagine a forest attaining either worth or majesty under a scheme that, somehow, removed the obstacles and preserved the myriad plants without struggle and without casualties?

It would be a weird thing, that forest. It would have little tenacity, nor much of that subtle something that, in human beings, we call "character."

There would be no gnarled oaks or towering pines, since the buffetings of the winds that induce the one and the struggle toward the sun that cause the other no longer would shape the trees.

There would be no deep-probing tap roots nor far-spreading laterals, competent to gather sustenance and establish steady anchorage. There would be no stout bark, nor thorns on any plants, nor fulsome blossoming, nor abundant production of seeds or fruits—for these are devices of defense or endeavor to survive and reproduce the species.

It would, I think go much like this with humanity if, by governmental interventions, humanity could fully halt the competitive struggle or if, by governmental aides, humanity succeeds in getting many more of the obstacles removed from its path. Men still need the incentive of need to spur them to effort; necessity still is the mother of invention; and both rewards and miseries still are the potent forces that drive men on or punish the slothful and the hindering.

I would not have you understand that I am condemning all governmental activities. There are, certainly, fair fields for governmental endeavor. The best known of them are the protective fields—the army, the navy, the police, the forces of law and order, the courts, the recorders of public documents, and many other institutions should and must be provided by government.

In an intricate industrial society, government well may regulate, and should do it, fearlessly and fairly, thereby curtailing predatory business practices. I do not condone them nor condone any of the financial high-jackings and fraudulent schemings that have robbed many people of their well-earned accumulations. What I would preserve is "productive industry," by which I mean the industry that produces the actual wealth of this nation. I have no interest in, or desire to preserve, such so-called "industry" as merely juggles the funds of the nation and palms a share of them with every motion of its clutching hand.

I am not addressing you as a reactionary. On the contrary, I consider it to be the best of liberalism to plead for the preservation of such a society, and such practices, and such compelling forces as will drive men on to better and finer achievements; as will bring them at last to prosperous and contented character and individual independence, as well as to an abundance of goods.

In the other direction, I think, lies ultimate national debility, dependence, and ultimate chaos. I would spare the American people from them. You would, too, I believe.

Where the Forests Are

ACCORDING to Frank E. Lathe, National Research Council, Ottawa, Canada, in article "World Natural Resources," *Science Magazine* of October 14, 1938, about two-thirds of the world's total forest resources is in possession of four of the world's political units, the U.S.S.R., the British Empire, Brazil and the United States:

	Percentage of the world's forest area
U. S. S. R.	21.1
British Empire (40 percent Canadian)	21.0
Brazil	13.4
United States	9.1
France and dependencies	3.9
Argentina	3.5
Japan	1.2
Germany and Austria	0.5
Italy and Abyssinia	0.4

"The world's annual growth of wood is about 38,000,000,000 cubic feet. If all forests of the world were properly protected and given reasonable care, it is estimated that they could produce annually 350,000,000,000 cubic feet. It is thus evident that an appreciation of the seriousness of the situation, coupled with the general application of scientific methods of forest protection and growth, would provide for the needs of a population much greater than that of today."

WEDNESDAY MORNING SESSION, JUNE 21, 1939

JOINT MEETING WITH THE ECOLOGICAL SOCIETY OF AMERICA

SUBJECT: SYMPOSIUM ON LAND USE

Chairman: L. R. Schoenmann

A BIOTIC VIEW OF LAND

BY ALDO LEOPOLD
University of Wisconsin

IN pioneering times wild plants and animals were tolerated, ignored, or fought, the attitude depending on the utility of the species.

Conservation introduced the idea that the more useful wild species could be managed as crops, but the less useful ones were ignored and the predaceous ones fought, just as in pioneering days. Conservation lowered the threshold of toleration for wildlife, but utility was still the criterion of policy, and utility attached to species rather than to any collective total of wild things. Species were known to compete with each other and to cooperate with each other, but the cooperations and competitions were regarded as separate and distinct; utility as susceptible of quantitative evaluation by research. For proof of this we need look no further than the bony framework of any campus or capitol: department of economic entomology, division of economic mammalogy, chief of food habits research, professor of economic ornithology. These agencies were set up to tell us whether the red-tailed hawk, the gray gopher, the lady beetle, and the meadowlark are useful, harmless, or injurious to man.

Ecology is a new fusion point for all the natural sciences. It has been built up partly by ecologists, but partly also by the collective efforts of the men charged with the economic evaluation of species. The emergence of ecology has placed the economic biologist in a peculiar dilemma: with one hand he points out the accumulated findings of his search for utility, or lack of utility, in this or that species; with the other he lifts the veil from a biota so complex, so conditioned by interwoven cooperations and competitions, that no man can say where utility begins or ends. No species can be "rated" without the tongue in the cheek; the old categories of "useful" and "harmful" have validity only as conditioned by time, place, and circumstance. The only sure conclusion is that the biota as a whole is useful, and biota includes not only plants and animals, but soils and waters as well.

In short, economic biology assumed that the biotic function and economic utility of a species was partly known and the rest could shortly be found out. That assumption no longer holds good; the process of finding out added new questions faster than new answers. The function of species is largely inscrutable, and may remain so.

When the human mind deals with any concept too large to be easily visualized, it substitutes some familiar object which seems to have similar properties. The "balance of nature" is a mental image for land and life which grew up before and during the transition to ecological thought. It is commonly employed in describing the biota to laymen, but ecologists among each other accept it only with reservations, and its acceptance by laymen seems to depend more on convenience than on conviction. Thus "nature lovers" accept it, but sportsmen and farmers are skeptical ("the balance was upset long ago; the only way to restore it is to give the country back to the Indians"). There is more than a suspicion that the dispute over predation determines these attitudes, rather than vice versa.

To the lay mind, balance of nature probably conveys an actual image of the familiar weighing scale. There may even be danger that the layman imputes to the biota properties which exist only on the grocer's counter.

To the ecological mind, balance of nature has merits and also defects. Its merits are that it conceives of a collective total, that it imputes some utility to all species, and that it implies oscillations when balance is disturbed. Its defects are that there is only one point at which balance occurs, and that balance is normally static.

If we must use a mental image for land instead of thinking about it directly, why not employ the image commonly used in ecology, namely the biotic pyramid? With certain additions hereinafter developed it presents a truer picture of the biota. With a truer picture of the biota, the scientist might take his tongue out of his cheek, the

layman might be less insistent on utility as a prerequisite for conservation, more hospitable to the "useless" cohabitants of the earth, more tolerant of values over and above profit, food, sport, or tourist-bait. Moreover, we might get better advice from economists and philosophers if we gave them a truer picture of the biotic mechanism.

I will first sketch the pyramid as a symbol of land, and later develop some of its implications in terms of land use.

Plants absorb energy from the sun. This energy flows through a circuit called the biota. It may be represented by the layers of a pyramid (Fig. 1). The bottom layer is the soil. A plant layer rests on the soil, an insect layer on the plants, and so on up through various groups of fish, reptiles, birds, and mammals. At the top are predators.

The species of a layer are alike not in where they came from, nor in what they look like, but rather in what they eat. Each successive layer depends on those below for food and often for other services, and each in turn furnishes food and services to those above. Each successive layer decreases in abundance; for every predator there are hundreds of his prey, thousands of their prey, millions of insects, uncountable plants.

The lines of dependency for food and other services are called food chains. Each species, including ourselves, is a link in many food chains. Thus the bobwhite quail eats a thousand kinds of plants and animals, i.e., he is a link in a thousand chains. The pyramid is a tangle of chains so complex as to seem disorderly, but when carefully examined the tangle is seen to be a highly organized structure. Its functioning depends on the cooperation and competition of all its diverse links.

In the beginning, the pyramid of life was low and squat; the food chains short and simple. Evolution has added layer after layer, link after link. Man is one of thousands of accretions to the height and complexity of the pyramid. Science has given us many doubts, but it has given us at least one certainty; the trend of evolution is to elaborate the biota.

Land, then, is not merely soil; it is a fountain of energy flowing through a circuit of soils, plants, and animals. Food chains are the living channels which conduct energy upward; death and decay return it to the soil. The circuit is not closed; some energy is dissipated in decay, some is added by absorption, some is stored in soils, peats, and forests, but it is a sustained circuit, like a slowly augmented revolving fund of life.

The upward flow of energy depends on the complex structure of the plant and animal community, much as the upward flow of sap in a tree depends on its complex cellular organization. Without this complexity normal circulation would not occur. Structure means the characteristic numbers, as well as the characteristic kinds and functions of the species.

This interdependence between the complex structure of land and its smooth functioning as an energy circuit is one of its basic attributes.

When a change occurs in one part of the circuit, many other parts must adjust themselves to it. Change does not necessarily obstruct the flow of energy; evolution is a long series of self-induced changes, the net result of which has been probably to accelerate the flow; certainly to lengthen the circuit.

Evolutionary changes, however, are usually slow and local. Man's invention of tools has enabled him to make changes of unprecedented violence, rapidity, and scope.

One change is in the composition of floras and faunas. The larger predators are lopped off the cap of the pyramid; food chains, for the first time in history, are made shorter rather than longer. Domesticated species are substituted for wild ones, and wild ones moved to new habitats. In this world-wide pooling of faunas and floras, some species get out of bounds as pests and diseases, others are extinguished. Such effects are seldom intended or foreseen; they represent unpredicted and often untraceable readjustments in the structure. Agricultural science is largely a race between the emergence of new pests and the emergence of new techniques for their control.

Another change affects the flow of energy through plants and animals, and its return to the

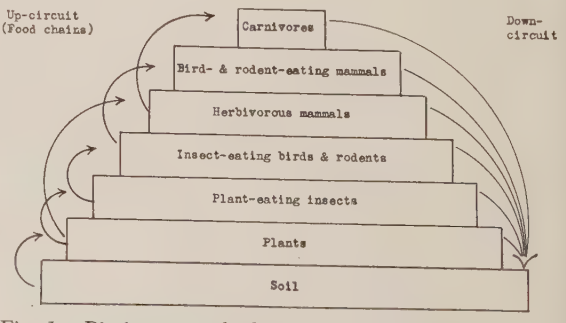

Fig. 1.—Biotic pyramid, showing plant and animal community as an energy circuit.

soil. Fertility is the ability of soil to receive, store, and return energy. Agriculture, by overdrafts on the soil, or by too radical a substitution of domestic for native species in the superstructure, may clog the channels of flow or deplete storage. Soils depleted of their stores wash away faster than they form. This is erosion.

Waters, like soils, are part of the energy circuit. Industry, by polluting waters, excludes the plants and animals necessary to keep energy in circulation.

Transportation brings about another basic change: the plants or animals grown in one region are consumed and return to the soil in another. Thus the formerly localized and self-contained circuits are pooled on a world-wide scale.

The process of altering the pyramid for human occupation releases stored energy, and this often gives rise, during the pioneering period, to a deceptive exuberance of plant and animal life, both wild and tame. These releases of biotic capital tend to becloud or delay the penalties of violence.

This thumbnail sketch of land as an energy circuit conveys three ideas more or less lacking from the balance of nature concept:

(1) That land is not merely soil.

(2) That the native plants and animals kept the energy circuit open; others may or may not.

(3) That man-made changes are of a different order than evolutionary changes, and have effects more comprehensive than is intended or foreseen.

These ideas, collectively, raise two basic issues: Can the land adjust itself to the new order? Can violence be reduced?

Biotas seem to differ in their capacity to sustain violence. Western Europe, for example, carries a far different pyramid than Caesar found there. Some large animals are lost; many new plants and animals are introduced, some of which escape as pests; the remaining natives are greatly changed in distribution and abundance. Yet the soil is still fertile, the waters flow normally, the new structure seems to function and to persist. There is no visible stoppage of the circuit.

Western Europe, then, has a resistant biota. Its processes are tough, elastic, resistant to strain. No matter how violent the alterations, the pyramid, so far, has developed some new *modus vivendi* which preserves its habitability for man and for most of the other natives.

The semiarid parts of both Asia and America display a different reaction. In many spots there is no longer any soil fit to support a complex pyramid, or to absorb the energy returning from such as remains. A cumulative process of wastage has set in. This wastage in the biotic organism is similar to disease in an animal, except that it does not culminate in absolute death. The organism recovers, but at a low level of complexity and human habitability. We attempt to offset the wastage by reclamation, but where the regimen of soils and waters is disturbed it is only too evident that the prospective longevity of reclamation projects is short.

The combined evidence of history and ecology seems to support one general deduction: the less violent the man-made changes, the greater the probability of successful readjustment in the pyramid. Violence, in turn, would seem to vary with human population density; a dense population requires a more violent conversion of land. In this respect, America has a better chance for nonviolent human dominance than Europe.

It is worth noting that this deduction runs counter to pioneering philosophy, which assumes that because a small increase in density enriched human life, that an indefinite increase will enrich it indefinitely. Ecology knows of no density relationship which holds within wide limits, and sociology seems to be finding evidence that this one is subject to a law of diminishing returns.

Whatever may be the equation for men and land, it is improbable that we as yet know all its terms. The recent discoveries in mineral and vitamin nutrition reveal unsuspected dependencies in the up-circuit; incredibly minute quantities of certain substances determine the value of soils to plants, of plants to animals. What of the down-circuit? What of the vanishing species, the preservation of which we now regard as an aesthetic luxury? They helped build the soil; in what unsuspected ways may they be essential to its maintenance? Professor Weaver proposes that we use prairie flowers to reflocculate the wasting soils of the dust bowl; who knows for what purpose cranes and condors, otters and grizzlies may some day be used?

Can the violence be reduced? I think that it can be, and that most of the present dissensions among conservationists may be regarded as the first gropings toward a nonviolent land use.

For example, the fight over predator control is no mere conflict of interest between field-glass hunters and gun-hunters. It is a fight between those who see utility and beauty in the biota as a whole, and those who see utility and beauty only in pheasants or trout. It grows clearer

year by year that violent reductions in raptorial and carnivorous species as a means of raising game and fish are necessary only where highly artificial (i.e., violent) methods of management are used. Wild-raised game does not require hawkless coverts, and the biotically educated sportsman gets no pleasure from them.

Forestry is a turmoil of naturalistic movements.

Thus the Germans, who taught the world to plant trees like cabbages, have scrapped their own teachings and gone back to mixed woods of native species, selectively cut and naturally reproduced (*Dauerwald*). The "cabbage brand" of silviculture, at first seemingly profitable, was found by experience to carry unforeseen biotic penalties: insect epidemics, soil sickness, declining yields, foodless deer, impoverished flora, distorted bird population. In their new Dauerwald the hard-headed Germans are now propagating owls, woodpeckers, titmice, goshawks, and other useless wildlife.

In America, the protests against radical "timber stand improvement" by the C.C.C. and against the purging of beech, white cedar, and tamarack from silvicultural plans are on all fours with Dauerwald as a return to nonviolent forestry. So is the growing skepticism about the ultimate utility of exotic plantations. So is the growing alarm about the epidemic of new Kaibabs, the growing realization that only wolves and lions can insure the forest against destruction by deer and insure the deer against self-destruction.

We have a whole group of discontents about the sacrifice of rare species: condors and grizzlies, prairie flora and bog flora. These, on their face, are protests against biotic violence. Some have gone beyond the protest stage: witness the Audubon researches for methods of restoring the ivory-billed woodpecker and the desert bighorn; the researches at Vassar and Wisconsin for methods of managing wildflowers.

The wilderness movement, the Ecological Society's campaign for natural areas, the German *Naturschutz*, and the international committees for wildlife protection all seek to preserve samples of original biota as standards against which to measure the effects of violence.

Agriculture, the most important land use, shows the least evidence of discontent with pioneering concepts. Conservation, among agricultural thinkers, still means conservation of the soil, rather than of the biota including the soil. The farmer must by the nature of his operations modify the biota more radically than the forester or the wildlife manager; he must change the ratios in the pyramid and exclude the larger predators and herbivores. This much difference is unavoidable. Nevertheless it remains true that the exclusions are always more radical than necessary; that the substitution of tame for wild plants and the annual renewal of the plant succession creates a rich habitat for wildlife which has never been consciously utilized except for game management and forestry. Modern "clean farming," despite its name, sends a large portion of its energy into wild plants; a glance at the aftermath of any stubble will prove this. But the animal pyramid is so simplified that this energy is not carried upward; it either spills back directly into the soil, or at best passes through insects, rodents, and small birds. The recent evidence that rodents increase on abused soils (animal weed theory) shows, I think, a simple dearth of higher animal layers, an unnatural downward deflection of the energy circuit at the rodent layer. Biotic farming (if I may coin such a term) would consciously carry this energy to higher levels before returning it to the soil. To this end it would employ all native wild species not actually incompatible with tame ones. These species would include not merely game, but rather the largest possible diversity of flora and fauna.

Biotic farming, in short, would include wild plants and animals with tame ones as expressions of fertility. To accomplish such a revolution in the landscape, there must of course be a corresponding revolution in the landholder. The farmer who now seeks merely to preserve the soil must take account of the superstructure as well; a good farm must be one where the wild fauna and flora has lost acreage without losing its existence.

It is easy, of course, to wish for better kinds of conservation, but what good does it do when on private lands we have very little of any kind? This is the basic puzzle for which I have no solution.

It seems possible, though, that prevailing failure of economic self-interest as a motive for better private land use has some connection with the failure of the social and natural sciences to agree with each other, and with the landholder, on a common concept of land. This may not be it, but ecology, as the fusion point of sciences and all the land uses, seems to me the place to look.

THE ECONOMIST'S APPROACH TO ECOLOGY

By GEORGE S. WEHRWEIN
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At the very outset it must be made clear that the field of ecology is foreign to the writer and therefore he begs indulgence with his blunderings at definition. The term *ecology* will be kept strictly within the physical non-human universe; it will not be applied to human society, although the writer is aware of its application in this field and also of the hectic controversies accompanying this application. His interest is primarily in the relation of ecology to the problem of the conservation of natural resources.

We will start with the assumption that the natural world was once in balance. The primitive forest consisted not only of trees but of shrubs, mosses, lichens, mold, bacteria, worms, birds, and animals living in interdependence. The same can be said of the grass lands. While erosion by wind, water, run-off, and floods were a part of this "balanced" world they played no such part as they do when the natural order has been unbalanced by man armed with machines, energy, and chemistry. Modern man has upset this balance and often set in motion a train of consequences of which he was ignorant, or was unable to stop because of the institutional and economic framework in which human society operates. To the extent that these assumptions are too broad or out of date the social scientist has to be set right by those working in the physical sciences dealing with soil, plants, and animals in their ecological interdependence.

It is of course self evident that modern civilization and life would be impossible without modifying and disturbing the original conditions. An uncut, ungrazed bluegrass sod may be perfect protection against run-off and erosion, but will not feed animals or nourish man. The quarrel is not with the elimination of forest and grass where some other land use is more useful to man, rather it is with the insistence on converting land into a use which is not even profitable, or with the manner in which this was done. Furthermore, the narrow concept of "proper" land use too often leaves out of consideration the interdependence of land uses and the fact that disturbance of a given sector may set up a succession of consequences which not only affect the land in question but also other land and other people and their activities, present and future.

Primitive man was more or less a part of the natural balanced system. His simple tools literally only scratched the surface and his feeble weapons did little more than place him on par with the rest of the animal world. This does not mean, however, that relatively primitive tribes may not have a detrimental influence on the environment. The goat and sheep of the Sinai Peninsula have practically devastated a land that once was more or less forested and had a flourishing agriculture wherever irrigation and dry-farming were possible. Major Jarvis says that the Arab is not the son of the desert but the father of the desert.[1]

In medieval Europe not only were tools and techniques such that man *had* to work more or less in harmony with nature but the feudal system was an institutional barrier to exploitation of the land. The forests were preëmpted for the chase and pleasure by the nobility, but in so doing much was done to preserve the natural condition of the forest. Since settlement could take place only with the consent of the feudal lord, no unplanned, "shot gun" type of isolated settlement was permitted. Since the serfs were directed by the lord of the manor, he could and did check anti-conservational practices. Furthermore, the complete dependence upon land for economic existence, for social position and political influence, gave farm and forest land an importance which cannot be appreciated in this modern age. Even for the lower classes the *privilege* to cultivate land meant economic security and "land ownership meant the supreme goal of life, guaranteeing personal and political freedom. This psychological pattern created by feudalism and manorialism," says Wantrup, "lasted until the time of the French Revolution and in most countries is effective even today."[2]

This example is worthy of citation at length because it illustrates the non-economic institutional influences—laws, customs, beliefs, and

[1]Jarvis, C. S. Three deserts. E. P. Dutton, N. Y. 1937, p. 160.

[2]von Ciriacy-Wantrup, S. Soil conservation in European farm management. Jour. Farm Econ. 20:90-93. 1938.

superstitions which often modify or soften the so-called economic laws and sometimes even nullify the economic urges of man. In many respects they are the framework within which economic principles operate. In the second place, this example brings out reasons for the difference in attitude toward the environment in Europe with a feudal heritage and America without this background.

Toward the close of the feudal era modern methods of farming were introduced with fertilizers and the "horse hoeing husbandry" of Jethro Tull. Moreover, animal power gave way to inanimate power through the steam engine, and then the world entered upon a new era. Minerals were mined for fuel and used to construct engines and machinery. This made man a super-animal and a geographical factor, no longer dominated by his environment but now dominating it in the fullest measure as commanded in Genesis. This significant fact was observed by George Perkins Marsh in his now oft-quoted book *Man and Nature* published in 1864. Inanimate energy and machinery gave man the power to denude the forests of almost half a continent in 150 years; with his earth-moving machinery he literally moves rivers and mountains. This new development also permitted the heaviest increase in population in the world's history and released man from the land to such an extent that in many nations more people live in cities than in the country.[3] Since every person in the Western World needs 2 to 2½ acres of arable land for his sustenance it means that at least this much of the earth's surface must be transformed from the original state to man-cultivated crops.

If there was any one time when man needed a guiding hand to direct his operations in harmony with nature it was at the very time when he emerged from a simple, predominantly rural economy to one supercharged with energy, mechanization, and urbanization. Curiously enough with the advent of the steam and machine age came the doctrines of Adam Smith as set forth in his *Wealth of Nations*, in 1776. Before his time the social and economic world had been under all sorts of regulations—from the guilds, the church, the feudal system, and the interference with trade under the mercantile system. The new philosophy espoused the doctrine of *laissez-faire*, of noninterference with the "natural laws" of economic life. Adam Smith stated the consoling doctrine that, in the main, whenever each person pursues his own self-interest he is automatically also acting in the best interests of society as a whole. The natural corollary follows that any restraint on the action of individuals not only is bad for the individual but also for society and the state. Whatever may have been the validity of this philosophy in commerce and industry it fails when applied to the conservational utilization of natural resources. Yet so influential became this doctrine that many European countries turned public forests over to private owners by the wholesale. Germany was among the first to discover the fallacy of this philosophy and soon reversed the trend in alienation of forest land.

Simultaneously with the development of new forms of energy and machinery and the Smithian philosophy of *laissez-faire* came the dissolution of the feudal system of land holding. The restraints of this system were exchanged for private ownership of land in fee simple and freedom to do with the land as the owner pleases, subject only to the shadowy rights of others. This doctrine reached its acme after the French and American Revolutions and in this country the Ordinance of 1787 abolished all restraints on the alienation of property. The significance of this for conservation lies in the fact that the owner was completely freed from all outside restrictions. He could remove the forests, destroy wildlife, and abuse the land within his own property line. However, the freedom of property was not considered to be illogical or detrimental under fee simple ownership, because why should an owner destroy or permit the deterioration of that which is his own? Unwittingly the door was opened wide for the exploitation of natural resources and the destruction of the balance of nature just at the time when America was being "opened up" at the close of our war for independence.

By 1800 a new kind of animal had appeared upon the scene, armed with unusual mechanized powers and by his own institutions relieved of practically all restraints on the use of these powers. Some of his characteristics are of consider-

[3]The fact that half of the people of the United States live in an urban environment is not without significance for the conservation of natural resources. Many of them are so far divorced from the soil that they are ignorant of the problems of conservation or so far removed from them that they mean nothing in the every-day life of the city dweller. Furthermore "economic urges" have the fullest and uninhibited sphere of action in the market place of the cities.

able importance in natural resource conservation. The "economic man" is urged into certain lines of action by the profit motive. He does not hesitate to convert natural resources into money to satisfy wants, wants which have gone far beyond mere food, clothing, and shelter. These three are usually taken for granted and the car, amusements, social prestige, and gadgets are often more of a driving force to get money than the necessities. Luxuries have a subtle way of becoming necessities.

In the second place, man is a relatively short-lived animal whose productive life is reduced by a long childhood at one end and voluntary or forced retirement at the other. During the productive period he brings up his family and the necessities of the case force him to "get while the getting is good." The chief characteristic of the present commercial age is the concern for the next few years only. Speaking of our "business civilization," James Truslow Adams says, "Most business men think . . . in one or two year periods . . . if he can make his personal profit by ripping the forests off the face of half a dozen states in a decade, he is content to let those who come later look after themselves.[4]

In contrast with this short time point of view the conservation of the environment requires thoughts for tomorrow and sometimes long, long thoughts resulting in policies which may call for curtailment of present use for the benefit of generations yet unborn.[5]

It is not that the modern man does not look into the future. He knows full well that he must save for old age and sickness, but he has devised insurance schemes, savings accounts, investments, and old age pensions. All these schemes call for savings and premiums in the present and this increases the pressure for immediate income rather than reducing it. "Economic man" is impelled to exploit resources today in order to have these forms of income tomorrow. Theoretically he could invest in resources and hold them or plant a forest to give him this future income; practically, it does not work out that way. The preference of the average individual for present income as compared to future income is to many economists an explanation of *interest* as an economic phenomena. The higher the rate of interest the greater is the premium on the present as against the future.

It may also be that man-made institutions force the individual into anti-conservational practices. The farmer with a heavy mortgage on his place may be driven to slaughter his woodlot or plant cash crops in place of soil-conserving crops. The reason often given for draining a marsh or straightening a creek is that the farmer feels he should get income on every acre that is taxed.

Another feature in the relation of mechanized economic man to his environment is the national and international exchange of products. Products of the land are grown in one region but consumed in another. Under primitive conditions with limited mobility, men and animals lived and were returned to the earth from which they were taken near the place where they were born, thus keeping up the cycle and the fertility of the land. Today the products of American farms are consumed in distant cities and across the seas, and human beings are in constant migration from the rural areas to the cities.

This factor has peculiar significance on the Great Plains. Nothing was lost from the land in the Indian-buffalo regime, but the loss began as soon as white men raised cattle and shipped them East. The disarrangement of the environment proceeded even faster when grain farming superseded grazing. Power and machinery have replaced the ranching economy with a highly soil-exhausting type of farming—one-crop grain farming which returns little or nothing to the soil. Besides, it has proved to be one of the most vulnerable types of farming since it exposes the bared earth to the action of wind and water. The small amount of labor required, the fact that the operator has to be on the ground only a few months in the year, and the use of large scale machinery have made this form of land exploitation one of the most inviting and exciting. It meets all the requirements of those who have a high time preference for income. The fact that there is considerable risk connected with it merely appeals to the gambling instinct of the average American. Then if the whole thing fails Uncle Sam is always ready to bail him out!

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[4]Adams, J. T. Our business civilization. Boni, New York. 1929. pp. 19-20.

[5]Policies require public action and the nation as a whole may be just as "short-run" minded as the individual. In fact every new nation exploits natural resources in order to build up its capital structure—farms, homes, factories, roads, railroads, and public buildings. Whether a collective society such as Russia will be more successful than other nations in conserving natural resources remains to be seen.

It is significant that the soils which invite and permit only one crop agriculture are the ones where the greatest unbalancing of the natural environment can be expected.

Conservation of natural resources, the maintenance of the landscape, or of the natural balance have long been the theme of discussion among economists. Economists cannot solve the problem. They can only explore human behavior, especially as conditioned by economic factors, with the hope of directing proper lines of conduct. What the objective of these lines of conduct are to be is also more or less unsettled and in many of its aspects is outside of the realm of economics.

The economist is equipped or should be equipped to set up a balance sheet of costs and income connected with the utilization or conservation of a given resource to guide the owner or the state in making decisions. Presumably he can tell whether a given technique "will pay" or not, but the economist immediately runs into the difficulty of deciding what "making it pay" means. Given a farm in full private ownership does it pay to devastate the land and the environment, spending as little as possible and taking out as much as possible and letting the farm go down the river in twenty years? Yet that seems to have been the test on many a farm in America. On the other hand, does it pay the owner who believes it his duty to pass the farm to the next generation in as good if not a better condition than he received it from his father?

To say that one has a short-time point of view while the other has a long-time viewpoint, which includes the welfare of his children and grandchildren, merely states the case; it does not explain the reasons why one man chose the short run and the other the long run. Under American conditions neither of the two landowners is under outside compulsion to do what he is doing. European farmers seem to accept the idea of a permanent and perpetual agriculture in harmony with the environment without asking whether it pays or not. This attitude is a part of their institutional inheritance mentioned previously. The European farmer seems to look to the future as naturally as the American farmer to the present or the herdsmen of Sinai who literally take no thought for tomorrow at all. Says Major Jarvis, "The future worries them not a jot, and with them time is not a dimension, it is merely a state of mind."[6]

These are some of the perplexities confronting the economist. Perhaps the examples chosen are too specialized and pertain too much to practical agriculture and not enough to the natural universe where the ecologists' interest lie. However, the writer is not unaware of this larger field.

In conclusion let me call attention to another phase of the problem lying not in the field of private action but in public policies of land utilization. Economists have made themselves unpopular by pointing out the uneconomic nature of many so-called public improvements such as navigation, drainage, and reclamation. Too often these are undertaken in the name of conservation and prove to be uneconomical from the standpoint of both the land user and the public body which sank money into the project. Settlers have gone broke on drainage projects, and bondholders, drainage districts, and counties have gone into bankruptcy. Furthermore, even though "economically feasible" the drainage of the area usually set in motion a train of circumstances affecting so many other factors of the formerly balanced landscape that the benefits are often outweighed by the damages. The trouble is that the engineering features dominate; economic and ecological aspects are ignored or considered irrelevant. "Ding" Darling has said that the Keokuk dam has created a "biological desert" and one wonders what other dams are doing to ecological set-up. There is work for both the natural scientists and the economist in planning land uses in harmony with physical and socio-economic laws.

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[6]Three deserts, *op. cit.* p. 143.

THE HUMAN SIDE OF LAND USE

By RAPHAEL ZON
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THE cutover region of northern Wisconsin, Michigan, and Minnesota is considered by many, next to the South, as the most serious problem area. The cause of the economic and financial difficulties of the region is usually ascribed to the depletion of its natural resources, particularly the forest. The cure generally advocated is rebuilding of the forest resources. Even if started immediately however, this will take 40 to 50 years. In this interval must one-fourth or one-third of the population be sustained by relief subsidies of one kind or another?

It is true that the forests of the northern Lake States have been largely cut out, but it is hardly true that the region as a result of this alone is so poor that it cannot maintain at least its present population on an economically independent and higher standard of living.

The region embraces some 57,000,000 acres, or 90,000 square miles. Of this, some 45,000,000 acres are classed as forest land, of which 2,500,000 acres are still virgin timber. The center of the northern hardwood industry and most of the pulp and paper plants are located within its territory. The region accounts for 85 percent of the iron ore produced in the United States. It still has some 18,000,000 acres of land which, in its most rigid interpretation, is suitable for agriculture, and yet only one-third of this acreage is in farm crops. It has a recreational industry which in magnitude is probably second only to New England and California. Certainly such a region cannot be classed as a region poor in natural resources or lacking in potentialities for growth!

Many European countries located within the same latitude and having about the same climate, and only one-half to one-third the area of the cutover region, support populations ranging from 2,000,000 to 6,000,000. Yet some economists claim that the cutover region cannot support even the meager population of 1,500,000 and advocate removal of some 20,000 people now stranded. The present population represents only 14 persons per square mile including the cities. If the urban areas are excluded the population will not exceed 4 or 5 persons per square mile, or about 2 families to a section.

The present economic plight of the people in the northern Lake States must be ascribed not so much to lack of natural resources as to misdirected land-use policies of the past and feeble efforts of today to correct these policies.

Among the causes of the present depression of the cutover region is, of course, the general stagnation of industry throughout the entire country. The cutover region is, after all, only a part of the United States and is affected by the same economic forces which affect the whole country. When the production of steel and copper is reduced, naturally the output of the iron and copper mines decreases. The displacement of man by machines is just as characteristic of the mines and the pulp and paper mills of the cutover region as in other industries elsewhere.

There are, however, some specific causes of the present condition of the cutover region. The northern Lake States was a region richly and still abundantly endowed with natural resources —timber, minerals, fish, game, and water. This region, however, for the most part was used by the industrial interests of the Middle West and East as a colony from which raw materials were exported without contributing to the building-up of the region itself. Think only of the millions of tons of ore that were shipped out from the mines of Minnesota and Michigan and for which the people of these states received a mere pittance and huge holes in the ground disfiguring the landscape! Think what the prosperity of the cutover region could be if, for instance, the iron ore going to Cleveland or Pittsburgh was made into iron and steel locally in the region itself, and think of the increased opportunities for utilizing the lower grade ore now left unused! Think of the enormous quantities of timber taken out from the region with no greater benefit to the local people than a mere subsistence wage for the worker in the woods and millions of devastated and burned-over lands and debts! Think of the "hit and miss" colonization of the cutover land by high-pressure methods of land companies, only too often placing the settlers on land unsuited for agriculture and, when the agricultural boom collapsed, leaving them stranded on their scattered farms! Even

in the recreational industry, which leaves more tangible evidence of development in the form of cottages and other improvements, the lion's share of what the tourist spends trickles back to the large industrial centers from which the oil, the canned goods, the sportsmen's outfits, and most other articles of the tourist trade come.

What is being done to remedy the situation? The federal government is buying some of the cutover land for national forest purposes, but still on a comparatively small scale. Of the 45,000,000 acres in the region, the federal government owns more than 6,000,000 acres, with the prospect of purchasing another 5,000,000 acres sometime in the distant future. Meanwhile other cutover land is being abandoned by the original owners by the millions of acres and is reverting to the state or county for nonpayment of taxes. The tax base of rural communities is decreasing and there is hardly a community in the cutover region which, if not completely bankrupt, is at least in financial stress. Reversion of the cutover land into federal and other public ownership is a movement which in the long run must react to the benefit of the people of the region. The mere public ownership of large tracts of cutover land, however, unless these tracts are energetically developed and utilized immediately, will not accomplish a great deal of good to the now living generation.

Timber-growing as a crop provides opportunity for employment. In some European countries where forest culture is an established practice, as agriculture is in this country, from 50 to 100 acres provide employment to one man a year. Suppose we would attempt to handle the 45,000,000 acres of forest land in the region on some semblance of forest culture, allowing, say, only 1,000 acres, or from 10 to 20 times larger area than in Europe, to occupy one man per year. The 45,000,000 acres would then afford opportunities for employment to 45,000 people per year, in addition to the 54,000 people now gainfully employed in the woods, sawmills, planing mills, woodworking and furniture industries, and pulp and paper industries. In the past labor in the woods was confined to cutting down trees, getting out logs either to the river or a railroad, or sawing the logs into lumber in the mills. The new forest work would involve planting, thinnings, and other cultural operations as well as harvesting of the crop itself.

Land classification and land zoning are also in the right direction but, again, are only palliatives because at present they aim merely to prohibit bad practices but are not constructive enough in themselves. What good is it to zone out a forest region in which no agricultural settlement is to take place if forest destruction within the forest zone goes merrily on? The mere concentration of land settlement on better lands and near highways may help somewhat in the reduction of county and township expenditures but gives no assurance to the farmers that they will make a living on the land when farmers on good land farther south and in old, established agricultural centers can barely make a living.

Yet the cutover region has considerable potentialities for agricultural development, but not in the old conventional manner as an individual farmer on a small tract of land struggling by himself and through his individual efforts to make a living on it, a Robinson Crusoe of the 20th century. Cooperative farming, possibly on land leased from the federal government, states or counties, with no mortgages facing the settlers, and the farm machinery bought and operated cooperatively, with cooperative marketing of their products, could tell an entirely different story. We already have in this country examples of such successful cooperative farms in Alaska and in some of the southern states. Some 137,000 people are now employed in agriculture in the cutover region, yet farming is confined only to about 6,000,000 acres of the 18,000,000 acres of land suitable for agriculture. Is it not conceivable that agriculture, if attempted on a cooperative basis, could afford employment to at least as many more people? The possibilities for profitable agriculture would still be greater if additional opportunities could be found for part-time jobs offering small cash income near the farm. This leads to the second great need in the region, namely, the need for small industries utilizing the raw materials still available in the region.

The housing conditions of the people in the cutover region are admittedly deplorable, as was brought out by several investigations. Yet within the region there are some 2,500 portable sawmills, there are millions of acres of aspen which rots without being utilized, and which the forest public agencies can afford to give to the local settlers either free or at a nominal price for the good of the forest itself. There are thousands of skilled workers who know how to build substantial houses. With cooperatively owned,

portable sawmills, with timber available at practically no cost, and skilled workers desiring better houses, the housing conditions could be improved with practically no cost to the public.

There are many small forest industries which could be built up in the cutover region today if they were at first initiated, encouraged, and even subsidized by the public itself. The slashings left after logging which feed the forest fires could be converted into a source of readily utilizable fuel. The souvenirs made of wood and offered to the tourists, now mostly made in Japan, could and should be all manufactured in the region itself. With woodcraft skill not yet entirely obliterated in the native population, especially the Indians, many useful articles could be made of local wood. While fuelwood for fireplaces is becoming a luxury in the larger cities, millions of cords of it rot in the woods only 100 or 150 miles away. With splendid highways and highly developed trucking, it is hard to believe that some way could not be found by which this large supply of fuel could be made available to a large number of people in the towns and cities. The possibilities of utilizing such species as aspen and jack pine in the manufacture of pulp, paper, and cellulose in general could be greatly increased, as well as utilization of these woods for construction purposes of all kinds. Within national and state forests some of the timber which is often sold to fairly large operators could be sold in small lots to local operators or to cooperative groups of woodworkers. If private capital, because of the risks involved, is not attracted by these possibilities, the public has enough at stake to justify making the initial moves itself.

The point which I am trying to make is that the reason why the cutover region is a problem case lies not so much in lack of natural resources as in the lack of opportunities to develop them for the benefit of the local population. It is true that the cream of the natural resources has been skimmed, but there is still enough left upon which to build an economically independent population. If this is true, then is it not about time for us to stop talking about the cutover region as a region of depleted resources and start developing public policies of better land settlement, better handling of our timber resources, and discourage the use of the northern Lake States as a colony for raw materials for the benefit of outside interests with little or no substantial development for the people of the region itself?

WEDNESDAY AFTERNOON SESSION, JUNE 21, 1939

SUBJECT: LAND UTILIZATION AND PLANNING IN THE LAKE STATES

Chairman: W. F. RAMSDELL

THE APPLICATION OF A LAND UTILIZATION PROGRAM TO THE CHIPPEWA NATIONAL FOREST

BY CLARENCE E. KNUTSON
U. S. Forest Service

THE Chippewa National Forest, located in north central Minnesota, has a gross area of 1,300,000 acres, of which approximately 600,000 acres are government owned. The remainder of the area is intermingled private lands, state lands, and Indian allotments. Some 200,000 acres, which were acquired in the period 1902-1923, now support a good stand of second growth and some virgin timber; the remainder is typical of the cutover portions of the northern Lake States. The original area of national forest land, now known as the Chippewa National Forest, was called the Minnesota National Forest, but in recent years acquisition purchase units were added and the name changed to the one now used. Living within the boundaries of the forest is a rural population of approximately 12,000 people.

In order to manage the government owned land for its highest use and to attempt a solution of some of the serious social and economic problems which are characteristic of most cutover areas, a land classification or rural zoning procedure has been used. This action was necessary to effect the adjustment of all lands within the forest to its highest use, based on maximum benefits to the public, and the translation of these benefits into terms of permanent rehabilitation through steady employment on forest farms, supplemented by the development and use of the forest resources, assuring social and economic security to a dependent forest population.

Meetings were held with all township boards. At these meetings the members of the township boards classified the land in the township as agricultural, recreational, and timberlands. This classification was made by considering each section, quarter section, or forty, and discussing its factors or merits from a land use standpoint. Most tracts were definitely known to the board members. The board immediately recognized the need for such action as a means of solving, in part at least, some of their problems of social instability, and to obtain revenue to meet township functions, tax delinquency, and the general well-being of the community. In classifying each tract the township board made the final decision on the basis of present and potential use of the land. The township board's recommendations were then correlated with available data on soil, population, recreation, wildlife, timber management, and tax delinquency. This correlation was accomplished by actual field studies. Areas classified as agricultural land were examined as to soil, cover, drainage, and also forest use land as to its characteristics. Population maps were prepared showing the location and number of persons in each family; lands used for recreational purposes were examined not only from their present use standpoint but potential use; checks were made to determine the location of the tax delinquent tracts. These actual field studies resulted in some few adjustments or changes from the recommendations or classification as originally made by the town boards.

A broad classification map of the forest was then compiled, based on the township boards' recommendations and all other available data. This map indicates the proposed areas which will be managed for agriculture, recreation, wildlife, timber production, experimental forests, natural areas, and proposed locations for consolidation of Indian lands. In checking our broad classification maps and proposed objective of management against our acquisition progress maps, we found that in all instances the three concentrations—namely, the population, the location of the land classified as agricultural by the town boards, and the areas where we were having difficulty in blocking our ownership—coincided very closely. This classification of agricultural and forest land was also in agreement with the indicated areas as outlined in the publication *Land Use in Northern Minnesota* by Jesness and Nowell. Around each agricultural

area a zone of influence, or the community working circle as it is sometimes called, was tentatively indicated. This zone of influence or working circle can be best described as the area required to supplement the supporting ability of the proper use of the agricultural areas as classified. We find that the zone of influence has to be modified to some extent after a unit has been studied. The farm area and zone of influence are then checked on the ground, after which meetings are again arranged with the township boards concerned and the plan discussed, minor adjustments made, and the plan approved by the township board. The approval of the county board, agricultural agent, and other agencies concerned is then secured.

The forest farm plan consists of sufficient maps, statistics, and descriptions to show the present status of ownership, sources of income, data on farm units, employment, roads, schools, tax delinquency, bonded indebtedness, and plans whereby economic and social conditions will be improved through land adjustments, by budgeting various forest resources, and by proposed community betterment projects.

In one area where we now have a plan in operation, it was found that very little land adjustment was necessary. The supplemental employment possible through small timber sales and the part time work on forestry projects now possible under present appropriations were all that were needed to make this community self-sustaining.

In another instance we had a fairly well settled community, practically no tax delinquency, adequate school facilities, roads, churches, and other community facilities. To supplement the income secured by farming, this community required approximately one-half million feet of timber per year which would be logged and marketed in a nearby town. Unfortunately, there is not sufficient timber available within reasonable distance of this community and there will not be under sustained yield for another twenty-five years. Through a cooperative agreement with the State of Minnesota, whereby it made available timber on state lands plus that now available on federal land, approximately three-fourths of necessary employment was found. Within reasonable distance of the community there is considerable acreage of land in need of planting. This land will be planted over a period of years and will about make up the difference in employment caused by lack of timber. The farmers in this area also desired a certain amount of pasture land which is being made available through special use permits. In certain years they also require a small amount of hay to supplement that which they raise on their own land. Wild hay land is therefore budgeted. Community betterment, land acquisition, relief, and bonded indebtedness are not serious problems in this community. Unfortunately, most of the areas are not in as good condition as this one, although we have found several where a reasonable land adjustment program would result in a sound economic setup.

In another community we found that we can only go part way, and that it will be several years before there is very much hope of the community being on a sound basis. The land adjustment situation is very serious. Bonded indebtedness and tax delinquency are bad. With these two problems we cannot assist very much except through the reduction of local expenses through consolidation of settlers. It will be another 25 or 30 years before there is sufficient timber available to furnish much supplemental employment through that source. There is, however, a considerable area in need of reforestation, and we are budgeting it as far as present funds permit. The land adjustment feature is progressing satisfactorily. If the bonded indebtedness and the tax delinquency problems could be solved, we shall have gone a long way.

In a third forest farm area which we recently studied, tax delinquency and bonded indebtedness are very serious. In this area, however, reasonable land adjustment will solve the inadequate school facilities and reduce the tremendous expense in road maintenance, especially snow removal. In this unit satisfactory private employment is available in the summer recreation business, but it would help conditions materially if we could offer winter employment.

In a fourth unit, which is located in the vicinity of the older portion of the forest, there is fairly good supplemental employment in woods work. This plan resolves itself into gradual readjustment of land ownership, budgeting of available timber resources through small sales, and some assistance by the county agent in community betterment projects.

The zoning and land planning work on the Chippewa National Forest as now being carried on is not designed to solve all the problems characteristic of the cutover portions of

the Lake States. It aims to go part way at least in bettering conditions for the persons concerned, and it will also aid the government units within the area. During the short time this plan has been in operation, some 35 to 40 readjustments have been made resulting in giving forest farmers a better opportunity to become self-sustaining and also reducing the cost of administration and local government functions on the part of the state, county, and township. For example, in the adjustment of two families through land exchange, the particular county concerned made a saving of more than $600 per year in road and school costs. The plan provides ample opportunity for all interested agencies to cooperate in the solution of land adjustment problems. It will not, however, be a "cure-all" since many problems of a social and financial nature will remain to be solved by other agencies, but through the procedure of zoning and land planning at least a part of the betterment job is being accomplished.

The success of our plans is dependent upon the endeavor of the forest people, and therefore our plans must be their plans, originating with them and designed to dedicate all the available forest resources to community stabilization and an improved standard of living.

LAND USE ADJUSTMENT PROGRAM OF THE SOIL CONSERVATION SERVICE IN THE UPPER MISSISSIPPI VALLEY

By L. E. SAWYER
Soil Conservation Service

THE land use adjustment program as it exists today was originally conceived under three separate emergency agencies. It includes the Soil Conservation Service originally established under the Department of Interior, drainage camps formerly operated by the Bureau of Agricultural Engineering, and the land utilization program originally established under the Land Policy Section of the Agricultural Adjustment Administration, later transferred to the Resettlement Administration, Farm Security Administration, Bureau of Agricultural Economics, and on November 1, 1938, to the Soil Conservation Service. These three separate programs, all conceived for the primary purpose of proper land use, have been placed under the administration of the Soil Conservation Service.

According to H. H. Bennett, chief of the Soil Conservation Service, "The basic purpose of the Soil Conservation Service, broadly stated, is to aid in bringing about desirable physical adjustments in land use with a view to bettering human welfare, conserving natural resources, establishing a permanent and balanced agriculture, and reducing the hazards of floods and siltation."

The philosophy underlying the establishment of these land programs is a direct reversal of the philosophy under which this country has been developed. For years we have been opening up new lands for settlement and apparently have been attempting to put every acre of land under cultivation. In the period immediately prior to and during the World War, extensive land clearing and drainage projects were undertaken throughout the Middle West. Vast areas were opened up for settlement, and thousands of families seeking new homes and under various inducements settled in these newly cutover lands and in areas supposedly prepared for agriculture by extensive systems of drainage ditches. Their attempts to survive in these areas were futile because of the mounting costs of local government, mortgage foreclosures, the ever-increasing burden of land and drainage taxes, and the inability of the land to provide a satisfactory income and an adequate living.

Parallel to the condition of these people is the situation of the farm families living on lands in the hillier portions of this region. In the earlier part of the century they were given every incentive to increase their acreage of cultivated land. Large holdings formerly devoted to grazing and the production of livestock were broken up into smaller units and a large portion of the acreage placed under cultivation. Under those conditions many fields too steep to cultivate under any conditions were plowed. For a few years they produced satisfactory crops, but erosion and the removal of the organic matter from the soil soon converted them into submarginal farms. During those days land values soared to heights which we may never see again. In order to purchase farms or to increase their holdings

many landowners incurred mortgages which they will never be able to pay.

The land use adjustment program of the Soil Conservation Service is directed toward correcting these conditions. An outstanding example of the type of project carried on under the land utilization phase of the program authorized under Title 3 of the Bankhead-Jones Farm Tenant Act is the isolated settler purchase project now underway in northern Wisconsin. Under the program of the Resettlement Administration three projects were originally established in northern Wisconsin, in Bayfield, Sawyer, Vilas, Florence, Oneida, Forest, Langlade, and Oconto Counties. In those three projects under the original program the holdings of 299 isolated settlers were purchased.

Land Purchase Reduces Costs

The land purchase in these three original projects is estimated to have made a saving in school costs of about $15,000 a year by enabling the closing of 12 rural schools. In addition, several thousand dollars of annual expense for school transportation has been eliminated. Road costs have been reduced by the elimination of much maintenance and snow plowing expense. Relief costs have been cut materially by placing many of these families in a position to make their own living. Finally, a large group of citizens has been established in settled areas where they have a chance[1] to obtain a reasonably good standard of living—where hope can take the place of despair.

The savings in individual cases and in certain counties is even more outstanding. "In Forest County, for instance, 124 tracts were purchased for a total of $99,268.22. In the 5-year period prior to May 1, 1937, this group received $52,000 in direct relief, and $24,537.86 from the W.P.A., or $76,537.81. This sum approaches the amount of money spent in purchasing their submarginal farms."[2]

The results of this original purchase showed conclusively that land acquisition as a supplement to rural zoning was a necessary tool to accomplish the ultimate purpose for which the zoning ordinances were established. As a result, the University of Wisconsin, the Wisconsin Conservation Department, and the zoning and land committees of the 24 counties in Wisconsin which have invoked zoning ordinances, requested that the scope of the purchase areas be increased. Such a project was approved September 19, 1938.

To date 81 tracts lying within 15 counties have been optioned. All these tracts are holdings that were designated by the land committees of the counties as particularly serious cases. In several instances the purchase of two or three tracts in a township will enable the county to close all the schools and a large portion of the roads, and will relieve it of the expense of transporting the children to school. It is estimated that the annual savings through the permanent closing of three schools and 73 miles of roads involved, together with the saving in maintenance cost and new construction that would have to take place if these settlers were to remain, will completely liquidate this year's purchase cost in a period of 3½ years. This does not include the savings in cost of direct relief.

After these lands have been acquired and the families have been relocated on farms or in other occupations where they will have an opportunity to make a satisfactory living and where they will not be a burden upon the county, it is proposed that the lands will be transferred to the Wisconsin Conservation Department to be administered as a portion of the state or county forests in which they lie.

The relocation of the families occupying the lands which are acquired in this program is assumed by the Farm Security Administration under a memorandum of understanding which charges it with the responsibility for relocating families whose lands are acquired, in so far as funds are available. The Farm Security Administration assists relocated farmers in developing their farm plans and provides rehabilitation loans where needed. Through its assistance all the families occupying lands acquired in the original program have been relocated. With a few exceptions, the families whose lands have been optioned have already made arrangements for their new farms and are prepared to move just as soon as it is possible to pay for the lands they now occupy.

The land purchase program as originally initiated comprised a total of 207 projects in the United States, involving the acquisition of 9,980,000 acres of land. Within this region, consisting of the states of Minnesota, Wisconsin, Illinois, Iowa, and Missouri, a total of 30 projects was originally established. Five of these have been transferred to the National Park Service,

[1]Gorden, L. G. Applying a plan for land and people. Land Policy Review, November-December, 16-20. 1938.

[2]Gorden, L. G. *Op. Cit.* p. 17.

five to the Biological Survey, five to the Office of Indian Affairs, parts of four to the U. S. Forest Service, one to Iowa State College, and one to the University of Missouri. There remain seven projects on which development work is being carried on and two additional projects in the acquisition stage.

Variety of Work Projects Established

These projects represent a variety of conditions and attempts to correct improper land use in a wide range of soils. The area covered ranges from the extreme southeastern portion of Illinois to north central Minnesota. In southern Illinois, the Dixon Springs project is being developed in cooperation with the U. S. Forest Service and the University of Illinois for a long-time pasture and erosion control demonstration project. The Crab Orchard Creek project in Williamson and Jackson counties, Illinois, is being developed primarily for water conservation and land use adjustment.

In southern Iowa, five separate farms have been developed for administration by the Iowa State College as demonstration pasture projects. In central Wisconsin, four sites have been developed—one a small roadside park, one as an extension of the Camp McCoy Military Reservation, and two consisting of an area of 150,000 acres for forestry and wildlife purposes. The Cedar Creek Project in Boone and Calloway Counties, Missouri, on which acquisition work is just starting, is to be developed primarily for grazing purposes.

Minnesota Projects Developed for Forestry and Wildlife

The extreme northern projects in northern Minnesota—Beltrami and Pine Island—comprising 1,500,000 acres, which are being developed for forestry and wildlife purposes, are to be administered by the Minnesota Department of Conservation. Emphasis is being placed on wildlife in the Beltrami project and on forestry in the Pine Island project.

These projects are located at the northwestern portion of an area of approximately 13 million acres of swampy, stony, or sandy land, so isolated that for the present time at least it is practically worthless for agricultural purposes. Out of this total project area of 1,550,000 acres, 1,200,000 acres have reverted to the state as a result of tax delinquency proceedings against private owners.

Eighty thousand acres are in public domain consisting of the so-called ceded Chippewa Indian lands. About 102,000 acres have been acquired or contracted for purchase in connection with the project, and 178,000 acres remain in private ownership. These two projects are excellent examples of the good that can be accomplished by the public acquisition of land in areas of this character.

When the purchase program was first initiated in these two Minnesota projects, 500 families were living within the established boundaries. To date the land of all but 25 of these families has been acquired or contracted for purchase. The families whose land has been purchased have been relocated on farms where they will have an opportunity to make a better living. The relocation of these people is set forth in two publications[3,4] well worth careful reading.

The areas have been stocked with woodland caribou, moose, elk, deer, beaver, muskrat, and other fur bearers indigenous to that portion of the United States. Woodland caribou were transplanted from Canada to Minnesota to replenish the herd, which had dwindled to three cows. Construction of the dams in the drainage ditches and the transplanting of beaver has trebled the population of that species since the development program was initiated.

Water Levels Restored

One of the main features of the development program has been the restoration of the water levels which existed throughout the areas prior to the time that the drainage ditches were opened. This work has involved the construction of many timber dams which, when the water table is raised to its former height, will provide a water barrier against fires. The effectiveness of these water barriers for fire protection and the effect that the depopulation of an area has on fires were evident last fall. At that time many disastrous fires occurred in northern Minnesota and the portion of Ontario immediately across the border, but during the entire period no serious fires occurred in either the Beltrami or Pine Island projects.

It is hoped that with the completion of the

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[3]Wilson, A. D. Settler relocation: A description of the Minnesota plan. Journal of Land and Public Utility Economics. 14:402-416. 1938.

[4]Murchie, R. W., and C. R. Wasson. Beltrami Island, Minnesota, Resettlement Project. Minn. Agric. Exp. Sta. Bull. 334. 1937.

purchase program, the construction of the remaining dams to be built in the drainage ditches, and the protection to be afforded by the state, these vast areas can again produce timber, wildlife and game—the purpose for which nature intended them.

Through the properly directed public acquisition and development of lands in areas of the character described, and through the application of the necessary erosion control and land use programs on lands that are to remain in agricultural production, every effort is being made to achieve the basic purpose of the Soil Conservation Service.

SOME PHASES OF COUNTY PLANNING IN MICHIGAN

By PAUL A. HERBERT
Michigan State College

COUNTY planning may be defined as a deliberate effort to describe and outline a comprehensive method of action which if followed will improve the well-being of the inhabitants and prospective inhabitants of the county, with the ultimate utopian objective of maximizing that well-being. However, these results should not be achieved at the expense, or to the disadvantage of, other counties. Obviously then the formulation of such a plan of action for one county should be coordinated with those of other counties.

The term county planning should, from the etymological viewpoint, include urban, suburban, and rural planning. The word *rurban* has been introduced as a synonym for county planning, although in its more restricted use rurban has been confined to the rural-urban relationships. Then, too, county planning at times has been used to connote only the rural and suburban planning of the county.

To reduce this confusion the term community planning probably should be favored rather than county planning, particularly because plans to be fully effective must eventually be based upon the community as the unit, because the county seldom spatially coincides exactly with one or more communities.[1] Unfortunately, community is also used very loosely in that we often speak of urban communities and rural communities as if they were two distinctly separable units.

Regardless of its geographic limits, community planning applies to the planning of man's activities involving man-to-man and man-to-nature relationships. By no means is it confined to his land relationships, although, at this embryonic stage of planning, land planning is one of the aspects of community planning best understood and most frequently undertaken.

It is obvious that it would be presumptuous for any one person to discuss in detail all phases of community planning. However, a properly trained community planner would have the ability to coordinate the work of the several planning technicians. Such a community planner would find a fertile field in Michigan, and, I presume, in other states, because no comprehensive community plans of development have been prepared nor are any contemplated save in the vaguest terms. Indeed, there has yet to be gathered and synthesized the biological, economic, physical, and social data necessary to prepare a trustworthy community plan.

The Michigan State Planning Commission, hampered by inadequate and uncertain appropriations and by ever-changing membership as governor has followed governor, has not given planning the necessary leadership or the supervision so important in initiating community planning. The next two years promise to be particularly barren because the legislature has not seen fit to appropriate any funds whatsoever to the commission.

Nevertheless, a considerable quantity of reliable and correlative data have been gathered during the past sixteen years that would form an appreciable part of the factual basis for community planning. Many of these data were gathered, unfortunately, for specific purposes by various public agencies working independently, and hence the work of synthesizing will be considerably more than if a strong planning commission had acted as a correlating agency. Additional fact-finding inventories are now under way, such as those in land utilization, roads,

[1]Herbert, P. A. Rural community planning. Jour. Forestry 36:1099-1106. 1938.

schools, public finance, and health; these augur well for continued but slow progress despite apathy toward the State Planning Commission.

But I would not paint too bright a picture, because sound progress in planning is still hampered by fundamental differences of opinion in the inventory of basic data. For instance, Dr. Hammer[2] speaking at a farm appraisal conference only last fall insisted that, "the mapping of soils does not of itself tell *much* (the emphasis is my own) with respect to the productivity or value of the land." At another time a director of an agricultural experiment station when questioned as to why crop specialists did not make their studies and recommendations in terms of specific soil types, answered that only soil specialists understood soil maps.

In view of these comments, it is of interest to list the objectives of soil mapping as given by Kellogg:[3] "(1) to determine the morphology of soils, (2) to classify them according to their characteristics, (3) to show their distribution on maps, and (4) to describe their characteristics, particularly in reference to the growth of various crops, grasses, and trees." Of these objectives, the third and fourth interpreted to mean the location of soils on the basis of their productivity alone can justify the extensive soil mapping now going on throughout the country. If these objectives are not met, then a critical reanalysis of soil survey policies and practices should be undertaken at once.

Thus, Dr. Hammer[4] suggests that the present method of soil classification and mapping should *include* a method of ". . . . classification and analysis which lays the emphasis upon the component parts of the soil rather than the complex as an organic unity." In an experimental study made in Missouri, a significant degree of correlation was found to exist between physical yields or money value and individual soil characteristics. The characteristics used were: (1) surface soil texture, (2) depth of surface soil, (3) degree of slope, (4) surface soil lime requirement, (5) ratio of clay content of subsoil and surface soil, (6) exchangeable bases, and (7) surface soil nitrogen, potassium, and phosphorous content.

Many of these characteristics are not directly considered in present day soil mapping for "classification is based mainly upon the physical properties and conditions of the soil" as was the procedure at the turn of the last century.[5] The only chemical tests now used on occasion in the field are for carbonates and hydrogen-ion content, because ". . . . field tests for available plant nutrients, such as phosphorus, have not been developed to the extent that definite recommendations can be made now."

Undoubtedly there are both technological and practical limitations that once made it necessary, and that perhaps still apply to a degree, so that soil classification must be based upon easily observable physical characteristics. But I repeat that soil surveys to justify their cost to the taxpayer must be of such a nature that soil productivity can be determined therefrom, and so if the "differential approach" suggested by Dr. Hammer is still unworkable some other method must be used, such as the deductive method of Kellogg[6] wherein the usual soil types as units are assigned productive values on the basis of experience.

So from an inventory of the necessary soil data, the first office compilation for land planning evolves. This has been termed a "classification of natural land types."[7] It is based strictly upon relatively permanent physical conditions, and I believe it should give for each piece of land the physical production of the principal agricultural, tree, grazing, and wildlife crops that can be produced under ordinary husbandry practices for a specific piece of land.

The independent work of the soil scientist ends with the inventory of the soil data. In collaboration with production technicians in the several fields—horticulture, farm crops, forestry, and grazing—he will prepare the natural land type map and classification. At this point the soil scientist has usually completed his part of a land planning project, and the land planner takes charge.

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[2]Hammer, C. H. Land classification as an aid in appraisal. Farm Appraisal Conference, October 28, 1938. College of Agriculture, University of Illinois, Urbana, Ill.

[3]Kellogg, C. E. Soil survey manual. U. S. Dept. Agric. Misc. Publ. 274, 1938.

[4]Hammer, C. E. *Op. cit.*

[5]Whitney, M. Field operations of the Division of Soils in 1899. U. S. Dept. Agric. Report 64. 1900.

[6]Kellogg, C. E. and J. K. Ableiter. A method of rural land classification. U. S. Dept. of Agric. Tech. Bull. 469. 1935.

[7]Kellogg, C. E. *Op. cit.*

The land planner applies the economic and social interpretation to the physical data supplied by the soil scientist and the production technicians with the objective of converting their natural land types into land use classes. To do so he must be broadly trained in the humanities, particularly in economics, political science, social psychology, and sociology.

Before the land planner can prepare a land use map he must consider all the dynamic factors which may affect immediately, or in the near future, the value of the physical product that the land will produce. He must determine for each probable product the costs of production, conversion, transportation, and marketing, the value of these products on the market, and probable changes in costs or value. It is in forecasting near future demand that his knowledge of social psychology will come into play, and in considering the tax burden, both as it will affect costs and demand, he will apply also his knowledge of political science.

Many noncharacteristic situations must be evaluated by the land planner. For instance, for some areas he will have to determine the cost of adequate drainage, for others, erosion control costs, for still others, the cost of stone or stump removal. In other areas he must determine the effect of the productivity depletion rate resulting from erosion or soil depleting crops which cannot be offset at usual cost by correct husbandry or other practices. In these matters he must consult with engineers and other technicians who can supply him with the technical data necessary to determine costs and other disutilities involved.

With the natural land type map and his economic data before him, the land planner can now compute the probable net income that should be obtained from each major product that might be produced upon each piece of land. For most of the land, the type of product that will produce the highest net income will determine its land use class.

However, the land planner will find areas, usually marginal or isolated tracts, that for one reason or another should not be classified on the basis of their highest net income. For example, an undeveloped section of good agricultural soil, which is surrounded by forest land and which if developed would make it necessary to organize a new township, build a new school or road, might not be classified as agricultural land, because of the additional tax burden that the new development would impose. Or again, a forty of agricultural land on an existing highway, but far removed from other homes and from the community center, might not be thrown into the agricultural land use class, because of the inhospitable social conditions surrounding life there.

Finally, the land planner must scrutinize all the economic, physical, and social data to determine whether a land use not measured by the growing capacity of land might not yield the highest net income or for other reasons be socially desirable. Thus, the soil type, the natural land type, and a preliminary land use classification of a mile wide strip along a lake shore might indicate that timber production would return the greatest net income. However, it might well be found on the basis of probable near-future recreational demand that the highest net income, or social income, would be obtained if the first quarter-mile margin along the lake were placed in the seasonal resort land class, the next quarter-mile in a scenic-selective cutting forest class, and only the last half-mile into the timber production land use class.

Where the advantage of one land use over another is small, or where the business unit may affect the rating of a marginal piece of land, the land planner often will have to consult with production technicians before assigning a land use class to the area under consideration. For instance, the farm manager's aid may be needed to determine whether a piece of land, which considered alone would be placed in a forest land use class, should not be placed in an agricultural use class because adjacent farms would be more profitable business units if this forest land were cleared and operated as part of these farms.

The natural land types of the soil scientist are relatively permanent, subject only to alterations by major discoveries that would change the amount of physical product; on the other hand, the land use classes of the planner, while based in part upon the natural land types, are not permanent, but are open to change as economic and social conditions change. Hence, the land use classes must be subjected to periodic scrutiny and revised as needed, if economic and social inequities are to be prevented.

To what extent have Michigan's land planning efforts conformed to the optimum pattern de-

scribed? The justly famous Michigan Land Economic Survey, a pioneer in the field, was primarily an inventory, collected by technicians in the several disciplines: soil specialists, foresters, and economists. Its purpose was broader than land planning and so it collected data not always essential to such planning, but it also neglected to collect other information that we now consider basic to accurate land planning.

During the latter years of its existence its staff endeavored to interpret some of the data. Several preliminary land use plans were drawn, and although these maps were not preceded by a natural land type classification based upon productivity nor by detailed economic and social interpretation, nevertheless, both of these steps were taken into consideration indirectly as measured by soil types, tax delinquency, and ownership.

It is important to remember that this inventory and these land use maps were prepared by a state organization without local help. However, the inventory and the plans were explained to the local people even at times with much fanfare, but the people as a group never evinced more than polite interest. This, I believe, explains why the Michigan Land Economic Survey was one of the first state agencies to bow to a depression legislature; its miscellaneous data had received little direct use, it was too detailed and hence costly for a general survey, and not detailed enough to answer specific questions. For example, when the Conservation Department, which sponsored the survey, had to determine the value of a forty before offering it for sale, it usually still found it necessary to send an investigator into the field. So while the survey will never be revived in its original form, it did much to make Michigan conscious of its cutover land problem, and basic soil data collected by the survey can be converted to natural land types with little effort.

Even when the Michigan Land Economic Survey began its work, there was much public recognition of one phase of the land planning problem,—that of aiding the farmer-purchaser of cutover land in selecting land of good agricultural possibilities. The legislature in 1923 enacted a law[8] under which authority is granted to the State Department of Agriculture to create a list of land dealers and owners who only sell land of which a detailed land economic survey has been made by an approved and properly qualified examiner. The findings are certified by the department and a copy given to the owner and another filed with the registrar of deeds in which the land is located.

The object of the legislation was excellent. It failed to accomplish its purpose because the land buyers were not aware generally of the existence of this method of checking on land quality and hence did not demand certified land from dealers. Even those dealers and owners who had only good land to sell did not give the law publicity because they had to pay all the cost of the survey and certification.

Another land planning effort was the agricultural land classification study in which a dot map divided the land of the state into three classes, the third class being generally unsuited for agriculture.[9] This study was based upon the intimate knowledge of the state by the author, Professor J. O. Veatch, who as a soil scientist relied primarily on soil data for his classification, although he tempered the classification with his personal recollections of economic conditions prevailing in each locality.

Obviously, the study cannot be considered of sufficient detail or accuracy to permit the drawing of definite land use class lines. Its chief value lies in its provocative force to bring about actual land planning and to furnish data for the construction of problem area maps. Such a map was prepared by the land planning consultant of the Michigan State Planning Commission. A somewhat similar map was drawn by the field men of the Resettlement Administration in consultation with local leaders, and it formed one of the guides used by that organization in developing its program.

Further factual data valuable in land planning have been obtained from other recent federal projects. The aerial surveys of the Agricultural Adjustment Administration will supply much accurate cultural and physical data; the state highway survey, data on road use and costs; and the rural tax survey, physical data and ownership of all privately owned rural land. These data, however, will require careful checking, because many of them were collected by relief

[8]Act 292, Public Acts of 1923. Michigan.

[9]Veatch, J. O. Agricultural land classification and land types of Michigan. Mich. Agric. Exp. Sta. Special Bull. 231. 1933.

labor not generally considered very accurate. As the projects overlap checking will be facilitated.

Next in chronological order came the work of preparing the only two land use plans that have legal status in rural Michigan. Marquette County, after a favorable referendum, zoned the rural part of the county by local efforts initiated by the county highway engineer whose interest was captured by the problem because of the high per capita cost of road maintenance, including snow removal, upon those roads serving few permanent residents. Only three zones were established: forestry, recreational, and unrestricted. The plan is based almost entirely upon present use and road pattern. The unrestricted zone includes all land where farms and roads are now located. However, as Marquette County still has large areas of forest land the forestry zone is predominant.

This plan is frankly an opportunistic one, to permit immediate zoning upon meager data, but with strong local support and with the distinct understanding that zoning adjustments will be made where and when needed after more careful field examination. As a plan "to close the door before *all* the horses are stolen," it has much to commend it.

Delta County, in which Escanaba is located, supplied the initial support for the bill to make rural zoning legal in Michigan, and it was the second county zoned. The driving force in that county was not a public official faced by problems caused by the malutilization of land, but by a public spirited agricultural teacher who had studied land planning. The Delta County zoning ordinance is only slightly less opportunistic than that in Marquette County. The people did have, for reference in preparing their plant, an extensive soil map that to a degree resembles the natural land type map suggested here.

While various other public agencies in Michigan are here and there studying phases of the land planning problem, the only state-wide project now underway is the land mapping and classification project initiated by the federal extension service and described in the June issue of the JOURNAL OF FORESTRY.[10] This project bids fair to be the most successful nation-wide planning project yet attempted.

Although it falls far short of following the optimum technique described in this paper, the mature experiences of the local people form the basis for the preparation of county maps showing what land should not be in agriculture and what lands are of problematical agricultural value, or at least require a change in farm management practices. While obviously incomplete as land plans and in spots inaccurate, these county plans are arousing local interest and obtaining local support for planning activities, so that when the soil scientist and land planner are ready to refine these general plans their activities should find the necessary local cooperation.

So while Michigan today has not yet reached the stage where community planning is a recognized undertaking, we are cheered by the fact that out of the present interest and efforts at least the technique for the land zoning phase of community planning must soon appear. Such technique will require a re-orientation of the work of most soil scientists so that natural land types based upon productivity can be mapped. It will require the training of land planners, equipped to solve economic and social problems, who will evolve land use class maps from the physical data supplied by production technicians and the soil scientist. However, the speed and the success with which land planning and community planning become a vital force are dependent not only upon correct techniques but upon close cooperation between the various specialists involved, and, last but not least, upon local understanding and participation not only in the application of the plans but in their preparation. So present planning activities of local groups are as necessary as the more precise experimentations of the scientists. Planning will only be permanently successful when and where the knowledge of the scientist is applied to local problems with the understanding and support of the people for whom the plans are drawn.

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[10]Barraclough, K. E. County land use planning. Jour. Forestry 37:460-462. 1939.

ACCOMPLISHMENTS IN FIRE PROTECTION IN THE LAKE STATES

By J. ALFRED MITCHELL
Lake States Forest Experiment Station

FROM time immemorial, forest fires have played a prominent part in the history of the Lake States. There is evidence that even before the coming of the white man, lightning fires and fires set or allowed to escape by the Indians burned frequently and devastated wide areas. In the early days of settlement fires resulting from land clearing did much damage, while during the heyday of lumbering disastrous fires were a common occurrence.

The Peshtigo fire of 1871 which took over 1,500 lives, the Manistee fire of the same year which burned across lower Michigan from Lake Michigan to Lake Huron, the Thumb fire of 1881, the Hinkley fire of 1894, the Chisholm and Metz fires of 1908, the Baudette fire of 1910, the Au-Sauble fire of 1911, and the Cloquet and Moose Lake fires of 1918 are all of historical importance.

It is hard for anyone not familiar with past conditions to realize the progress that has been made by the Lake States during the quarter century in which organized protection has been in effect. Today, for example, the traveler in the North is seldom out of sight of a lookout tower. At frequent intervals, he passes a well equipped protection headquarters, ranger station or C.C.C. camp, where during hazardous periods trained fire fighters and fire trucks loaded and ready to go at a moment's notice "stand by" waiting for a possible fire call. Along the roads, at camp sites, in post offices, stores, and hotel lobbies, he is confronted with posters and signs warning him to put out his camp fire, to be careful with fire in the woods, and to notify the nearest conservation officer or ranger if a fire is discovered. He may even be stopped from time to time and cautioned to not throw burning tobacco or matches from his car. In general, also, settlers are now required to obtain permits from their local fire wardens before setting fires, and during dangerous periods burning may be prohibited and hazardous areas closed to public use.

When fires do occur, it is only a matter of minutes, under normal conditions, before they are detected by a lookout, reported to protection headquarters, and suppression crews are on their way. While shovels are still essential equipment, the fire fighter's effectiveness has been enormously increased by providing him with back pack pumps, special tools, and power equipment. Transportation and communication facilities have also been tremendously improved, and for the most part reasonably ample and smoothly functioning protection organizations have been developed.

Contrast these conditions with conditions prevailing twenty-five years ago. Michigan, for example, at that time had an annual appropriation for fire protection of $10,000 (today it spends over half a million). The state protective organization consisted of a chief fire warden, a railway locomotive and right-of-way inspector, ten game, fish and forest fire wardens, and twenty-five (more or less, depending on the season) short term fire wardens.

The other Lake States were not much better off. The game, fish and fire wardens, being primarily game men, looked on fire protection as an unwelcome duty of secondary importance. The special fire wardens, on whom the burden of protection rested, acted as patrolmen, posted fire warnings, fought such fires as they could with local help, and reported on fires that occurred in their respective districts. There were no lookout towers, few telephones, no local protection headquarters, no fire fighting equipment except as provided by the men themselves, and travel for the most part was on foot or by horse and buggy, although a few of the district wardens had cars.

In reviewing an old inspection report, I note that as late as 1918 one district warden was nine miles from the nearest telephone; that, of the patrolmen interviewed, only one carried a shovel (which he admitted was primarily for use when his car got stuck in the sand); that, although three 35-foot lookout towers had been ordered, only one had been erected and that on a private game preserve. The inspector notes also that the suggestion that fire wardens be provided with maps of their districts was turned down as "too technical."

Although little was, or could be, accomplished by these pioneer fire wardens in the way of fire control, they helped spread the gospel of conservation and did much to educate, if not to convert,

the local public to forest protection. There were certain zealots among them also for whom too much cannot be said. I have in mind such men as Rube Babbet in Michigan and Perry Swedberg in Minnesota who were so thoroughly imbued with the idea that, in season and out, they preached fire protection and carried on, often at their own expense, in the face of hopeless odds; asking only that they be given support in their efforts and men and equipment to make their work effective.

I have bumped for miles across the jack pine plains of lower Michigan with Rube Babbet in his old Model T, with a tomato can wired to the cowl for matches and cigarette butts, and listened to him deplore the burning of the woods and the carelessness and cussedness of people who were responsible and curse the indifference and lack of support of the legislature and the "brass hats" in Lansing who would not give him a few shovels and lookout towers or back him up when he arrested an incendiary or swore out a warrant for a settler caught wantonly burning when fires were bound to get away. If we had more of this crusading spirit in our present protection organizations, we would be further along than we are today with all our gadgets, streamlined equipment, and high-powered technique.

The passage of the Weeks Law in 1911 gave organized protection in the Lake States its first real impetus. Prior to 1920, however, effective fire control was largely confined to the national and state forests and to the holdings of a few timberland owners who, for the protection of their remaining merchantable timber, camps, and equipment, had organized local protective associations. From these nuclei, protective effort has spread until it now covers more or less effectively the entire forest area of the three Lake States. Progress, however, has been slow.

Wisconsin was first in the field with a comprehensive program of forest protection, but public support was lacking and State Forester Moody and his plans suffered the fate of most crusaders who are ahead of their times.

Minnesota next came to the front and developed what at the time was an outstanding state protection organization. Unfortunately, politics and lack of adequate financial support have prevented it from maintaining its lead, though much has been accomplished.

State wide fire protection in Michigan was late in getting under way. Inadequately financed, handicapped by politics, and subordinated to game work, it developed slowly, but in 1923 with the passage of the present forest fire law fire protection took a new lease on life and since then has developed rapidly.

Wisconsin, after its first abortive effort, marked time for several years, confining protection effort largely to its state forest area. Outside protection districts were set up in 1920 and considerably expanded in 1927, but not until 1930 did protection get under way on an effective scale.

Outstanding as an indication of the progress that has been made during the past two decades is the change in the attitude of the public in general and state protection organizations in particular toward forest fires. In 1918, public sentiment demanded little beyond the safe-guarding of life and property. No value was placed on second growth and fires that did not destroy merchantable timber, forest products, or improvements were considered to have done no harm. In fact, it was often argued that they were beneficial. Today, forest fires are generally deplored and the damage they do beside destroying merchantable timber is widely recognized. The necessity for prompt detection, quick action, and complete suppression is also now accepted as essential to effective fire control. Contrast this with the idea formerly prevailing, that fires were safe when they had ceased to run and could be left to burn themselves out where life and property was not immediately threatened.

Turning to available statistics, our only specific measure of accomplishment, we find that during the past twenty-five years over 110,000 fires were reported, 16,500,000 acres were burned over (about one quarter of the area protected), and damage in excess of $55,000,000 was done.

The peak year for number of fires was 1933, when over 12,000 occurred; 1931 holds the palm for area burned with a total of nearly 2,000,000 acres; while the peak year for damage was 1918, the year of the Cloquet and Moose Lake fires (in Minnesota), when losses amounted to over $28,500,000.

During the past ten years (1929-1938) on the average 7,374 fires have occurred, and 620,778 acres (approximately one percent of the area protected) has burned over annually. During the same ten-year period, the average loss reported has been in the neighborhood of $1,500,000 a year.

Of the 73,740 fires reported since 1928, 97 per-

cent were due to human agencies and hence, in most cases, could have been prevented. The chief offenders have been smokers, 34 percent; debris burners, 20 percent; incendiaries, 10 percent; campers, 7 percent; railroads, 6 percent; lumbering, 1 percent; lightning, 3 percent; miscellaneous causes, 15 percent; and unknown causes, 4 percent.

While the number of fires and area burned have varied widely from year to year, primarily because of weather conditions, the average number of fires per year increased steadily up until 1934. Since then, the mean annual number of fires has declined slightly and the current five-year average has decreased sharply. The mean annual burn, on the other hand, has remained practically unchanged since 1917 though the current average has fallen off during the past few years.

The chief indication of progress is to be found in the decreasing size of the average fire which, on the basis of mean area burned per fire per year, has decreased since 1918 from 518 to 231 acres, and on the basis of current five-year averages, from 552 acres in 1920 to 42 acres in 1938.

This substantial decrease in the size of the average fire, however, has been largely offset by the increase in number of fires. While the latter is partly accounted for by the more complete reporting of small fires in recent years, there unquestionably has been a material increase in the actual number of fires occurring as a result of highway development, the introduction of the automobile, and the greatly increased recreational use of forest areas. Whether or not the peak in number of fires and area burned has been reached remains to be seen. My belief is that present protective effort is sufficient only to hold the average number of fires and area burned at the present level, for while adequate under normal conditions the effectiveness of protection tends to break down in bad years with the result that gains made in good years are offset by the losses sustained when conditions are less favorable.

This raises the question as to what is adequate protection. If an average annual burn of one percent of the area protected is satisfactory for state-wide fire protection, it may be that the degree of protection now provided is adequate. If, however, current average losses are to be reduced and extensive burns eliminated, much remains to be done. Our ideas as to what constitutes adequate protection have gone up materially in the past and are likely to go up still more in the future. We have come a long way from the days when the protection of life and property was considered ample, but we are still a long way from having the fire situation completely under control.

While the record of the past few years has been increasingly good, experience shows that emergency periods may be expected at intervals of about eight years. We are now in the interval between such periods. Current figures, therefore, should not make us overly optimistic as to the future. That great progress has been made cannot be denied. Wholly satisfactory protection, however, has not yet been provided, and the danger of catastrophic fires has not been eliminated. Witness, for example, the burning of some 40,000 acres in lower Michigan this spring and the disastrous fires in Minnesota last fall. To what extent large fires can be eliminated is a question. This is particularly true in view of the large areas of hardwood and jack pine slash that are accumulating, and the increasing area of plantations which, in a few years, will constitute a major hazard. The increasing recreational use of forest land by the general public is also a problem; all of which points to the need for more and better protection if present losses are to be materially reduced.

On the other hand, since fires tend to occur more frequently and burn most readily where forest cover is lacking, the hazard in general should become less as the present extensive areas of second growth mature. Selective logging and the more intensive management of timberlands should also help make fire control more effective. Outside of intensively managed areas, however, fire protection is destined to remain a major problem.

FRIDAY EVENING SESSION, JUNE 23, 1939

The Friday evening session was held at Iron Mountain, Mich. The papers presented at this session were prepared to give a background to the actual field inspection of the Goodman operations. The Society is deeply indebted and highly appreciative of the many courtesies extended it by R. B. Goodman, the Goodman Lumber Company, and the Chamber of Commerce of Iron Mountain, Mich.

FORESTRY IN NORTHEASTERN WISCONSIN

By R. B. GOODMAN
Goodman Lumber Company

HERE in Iron Mountain, Mich., we are in the center of what was once a white pine forest. The pine was intermingled with hemlock and northern hardwoods. In pure stands, the pine frequently cut 30 M feet to the acre, and individual trees scaled 3 or 4 M feet.

In your trip tomorrow morning across the Menominee River into Florence County, Wisconsin, and south to Goodman, every creek and every small rivulet was once used to float the pine, basswood, and hemlock logs to the Menominee River and down the river to Marinette and Menominee, where there were sorting pockets for a dozen sawmills. From 1880 to 1909 more than ten billion feet of logs were brought to these mills. The rough air-dried lumber was loaded on schooners for the distributing yards in Chicago, whence it was shipped by rail to the prairie states.

By the year 1909, rail shipments had displaced river logging, planing mills were built at the sawmills, and carload shipments of lumber replaced cargoes. As the pine became depleted, hardwood mills were built within the remaining hardwood-hemlock forests. The Goodman mill was built in 1908. The Von Platen-Fox mill in Iron Mountain was built in 1910. Other sawmills were built at Wausaukee, Dunbar, Blackwell, Soperton, Wabeno, Newald, Laona, Crandon, and Rhinelander. You will pass through some of these towns and cities tomorrow, and through most of their tributary timberland. You will see some virgin timber, some second-growth, much restocking area, and some fairly successful agricultural settlement.

Following the earlier lumbering came pulp and paper mills, first at Marinette and Menominee, later at Rhinelander and at Niagara. By the 1920's decreased immigration and changing methods of agriculture ended agricultural expansion, and there was a marked decline in agricultural settlement in northern Wisconsin and Upper Michigan. There was also an awakening of interest in forestry and the conservation of the remaining forests of the region, though what the foresters talked about seemed theoretical and quite impractical.

The foresters condemned clear-cutting as destructive and advocated the preservation of the young timber by varying degrees of selective cutting. Stumpage values, however, were stationary and annual property taxes on timber reserves were increasing. In Lincoln County the annual tax on virgin timber increased from an average for the county of 12 cents an acre in 1894 to $1.80 an acre in 1922. This situation forced the timber owner to cut out and get out.

The other obstacle to forest management was forest fire. This afternoon you crossed the Peshtigo River and traversed farm land that was once the pine forests of the famous holocaust of October 1871. For sixty years after this tragedy, little was done to protect forests from fire. The immediate cause of building the mill at Goodman was to salvage several million feet of white pine timber which had been killed or damaged by fire in 1907, and as late as 1931, a season of extreme drought and high winds, fire destroyed a promising stand of second growth on nearly 15.000 acres of this company's forest.

These obstacles to forest management have been removed. In 1927 the enactment of the Wisconsin forest crop law, imposing a severance tax, saved the lands under forest management from tax exploitation. Beginning in 1931 the Wisconsin Conservation Department reorganized and augmented a decentralized system of fire prevention, detection, and suppression for the 12 million acres of forest region in northern and central Wisconsin.

Appropriate forest taxation and adequate forest fire protection changed the situation as to forest management. Most of the remaining timber owners have adopted woods practices for the protection of the residual young timber, and many of the larger operators have attempted selective cutting cycles, but this came so late that more than

two-thirds of the forest lands of northern Wisconsin had been cut and burned over and dropped for taxes.

Again the foresters found the remedy. The U. S. Forest Service began an acquisition program under the Wisconsin million-acre enabling act, now increased to two million acres. The Nicolet National Forest, during the past five years, has acquired several hundred thousand acres of forest land in the region. The foresters of the Wisconsin Conservation Department developed a cooperative program with the counties for the management of a large part of the tax-reverted cutover lands. Your trip to Goodman and Rhinelander will take you through or near six Wisconsin counties, Florence, Marinette, Forest, Langlade, Lincoln, and Oneida. These six counties now own and are managing more than 500,000 acres of forest land. During these years forest development has been conducted by the state, by the Forest Service, by C.C.C. and W.P.A. labor in forest improvement, building of fire lanes, slash disposal, and tree planting.

Now 90 percent of this region is under good forest management in public, farm, and industrial ownership. The forests are being managed to meet present needs with due regard to future forest productivity. These forests are protecting the soil from erosion, regulating stream flow, and the region is teeming with wildlife. Through forest management, forest industry, and indirectly through contributing agriculture, transportation, commerce, and recreation, it is supporting a resident population of 107,000 people, or 18 persons per square mile.

The ecology of this region has not been overlooked. Man has disastrously upset the balance of nature and the region is still economically depressed. Its errors in land use and forest utilization have been corrected. Federal, state, and county agencies, aided by relief employment, have carried on stream improvement, restoration of water levels, the restocking of the fish and game population, and the prevention of grass and leaf fires. The population has become conservation-minded.

The Extension Service of the Wisconsin College of Agriculture has developed land-use planning and this planning is secured by non-urban zoning ordinances. In these six counties more than three-fifths of the area is zoned against isolated settlement. In many places failures in land use have been overcome by the purchase of submarginal farms and their return to forest cover.

Nor has the social life of the region been neglected. Its churches, schools, gymnasiums, libraries, community buildings and hospitals, its hard-surfaced highways and secondary roads, its local governments and town meetings, its 4-H clubs, county agents, county fairs and granges, its local employment augmented by relief work, maintain a self-respecting, self-governing, industrious people closer to nature and for that reason happier and more virile than the residents of more densely populated urban centers.

This farm-forest region is in varying degrees typical of all northern Wisconsin and of Upper Michigan, in fact, of all the older farm-forest regions of the United States. In spite of all that has been accomplished, this particular area shares with all other farm-forest regions a serious apprehension.

The economic foundation on which these regions rest is threatened. There are now signs of approaching danger and the long future view is disheartening. Wood utilization is declining while forest productivity is increasing. I have said that the increasing forest productivity of all American forest regions is the outstanding achievement of the forestry profession, but it is an achievement which imposes a new responsibility. The profession is now beginning to recognize its responsibility for leadership in research in wood conversion and utilization.

The forestry schools have generally expanded the scope of professional forestry from silviculture to the study of forest products. This is a field in which scientific research has but scratched the surface, a field that in relation to its place in the national economy is inadequately financed and inadequately manned. A nation with a continuing burden of unemployment can ill afford to neglect the economic utilization of its greatest natural resource. The effectiveness of research in other fields of utilization has been proven by accomplishments in electrolytics, chemistry, metallurgy, mechanics, engineering, farm cropping, and animal husbandry.

The economic goal of decreasing prices, shorter hours of labor, increasing wages per hour, and the maintenance of a profit margin that will attract investment capital, can only be reached by improved industrial technique, and national prosperity must increasingly be found through technical research as the basis for industrial application. However, this research is highly competitive and what has been accomplished in the field

of substitutes for wood is significant. There are substitutes for lumber, for woodpulp paper, for wood chemicals, and even for wood cellulose. In this battle of the substitutes, the front line trenches are in the research laboratories. With an enrollment of more than 7,000 students in our forestry schools, the forestry profession can meet this challenge.

The validity of public expenditures for the acquisition of forest land, the planting and development of forests and their protection from fire, have been recognized. If national and state forestry are justified public undertakings, equally so is the research necessary to create economic utilization of the raw wood which forests grow. Even now more wood rots in the forest than is utilized.

In the region you are to visit tomorrow is a resident population of more than 100,000 people. If the utilization of the forest products of the region diminishes, employment diminishes, the tax base decreases, the population dwindles, and the region will become an economic liability on the rest of the state and the nation. There will be need for the removal of stranded population to other regions, creating new maladjustments. More farm lands will revert to forest land use and more forest products will rot in the forest. Expand this little segment of four million acres a hundredfold and it is evident that research in wood conversion and utilization is a public concern equally as important as agricultural research and ecological research for a sound national economy based on soil conservation and wise land use.

FOREST INDUSTRIES AT GOODMAN

By GEORGE A. HOUGHTON
Goodman Lumber Company

THE Goodman Lumber Company built its sawmill at Goodman in 1908. In connection with the sawmill there was a small planing mill which was electrically operated, but the sawmill was belt-driven. Horses were used in the woods for skidding and logs were brought to the mill on a logging railroad.

From 1908 to 1927 the timber was clear-cut and much of the cutover land was sold to settlers. The timber was cut at the rate of 20 to 24 million board feet a year. In 1927 the company changed to selective logging and it was necessary to reduce the annual cut to about 12 million feet.

The company had built a wood chemical distillation plant at Goodman in 1912. This plant provided a means of utilization of defective trees that had to be removed to improve the residual stand, and for the hardwood slash that had to be removed to protect the remaining timber from fire. In order properly to utilize the older timber removed in selective logging, the company built a veneer plant in 1928.

During the past ten years we have changed our power to steam turbines and have completely electrified the sawmill. We have added dry kilns in which we can dry thick hardwood green from the saw. We also have made extensive additions to the planing mill in order to finish kiln-dried hardwood dimension.

Under this integrated conversion, logs are inspected on the log deck of the sawmill. Some go to the band mills for the manufacture of lumber and ties; some logs are crosscut for the wood mill to produce chemical wood; some are cut into bolts for the veneer mill; and some are cut to lengths for flitches for the manufacture of hardwood dimension.

The products of the chemical plant are charcoal, acetate of lime, and methanol. Pre-driers have been added to the chemical plant so as to avoid the slow process of air-drying the wood for the chemical retorts. Synthetic products have seriously competed with the market for acetate and methanol, but the rapid expansion of chemical industries has maintained a substantial market for these products as well as for charcoal.

Paralleling these changes in conversion of forest products have been changes in the methods of logging at Goodman. The use of horses has been displaced by tractors in skidding, and we are preparing to abandon our remaining main line logging railroad of approximately 25 miles and substitute truck-hauling of logs.

In the merchandising of our products, our study has been largely of the consumer's plant and of the retail lumberman's lumber yard. In these studies to promote efficient utilization, we have had constant contact with the Forest Products Laboratory at Madison. This plan of mer-

chandising our products has resulted in finding the most appropriate use for each variety and grade of lumber, veneer and dimension, and has enabled us as well as our customers to reduce waste of material. A recent installation of edge-gluing equipment in the veneer mill is an instance of this saving of waste.

The increasingly technical requirements of the wood-using industries make necessary the constant development of refinements in conversion, from the log pond to the completed shipment. These refinements occur in methods of piling lumber for proper air seasoning, carefully prescribed schedules with controlled temperatures, humidity and circulation for kiln drying, more careful sawing and grading, and the introduction of precision machinery with minute tolerances. We can make veneer in various thicknesses from ¼ inch to 1/100 inch, and we can cut finished hardwood dimension to a tolerance of 1/32 inch. We can control moisture content within the narrow limits prescribed by the user. These are some of the technical problems in which we have been aided by the work of the Forest Products Laboratory at Madison.

Another important element in marketing is standardization of grades, which is accomplished through the inspection rules and services of the National Hardwood Lumber Manufacturers Association and the Northern Hemlock and Hardwood Manufacturers Association.

We market all our products in competition with other producers in Michigan and Wisconsin and in competition with the products of other forest regions, but fortunately this competition is not entirely a matter of price. Our system of marketing depends more on the quality of our product and our ability to establish ourselves as a permanent source of supply to industrial users. It is in this connection that we gain by our selective logging, our development of integrated conversion, and our program of sustained yield.

FOREST MANAGEMENT BY THE GOODMAN LUMBER COMPANY

By JOHN A. CARR
Goodman Lumber Company

THE operating timber block of the Goodman Lumber Company lies in the western part of Florence County, the northwestern part of Marinette County, and the eastern part of Forest County. It consists of 65,000 acres in all stages of growth from new reproduction to 250-year-old virgin hardwood. We will reach the end of our first cutting cycle in 1942, when the remaining 6,000 acres of virgin hardwood and hemlock will have been cut selectively. We are now managing a fine stand of 31,000 acres of the hardwood-hemlock type which was cut selectively during the years 1927 to 1939. These 37,000 acres of selectively cut timber will constitute the backbone of our productive forest during the next cutting cycle.

In addition we have 14,000 acres on which the trees range from reproduction to pole size and the species from northern hardwoods to aspen. This land will gradually become productive and be included in succeeding cutting cycles. About 11,000 acres of swamp timberland has been partly selectively logged for cedar poles, posts, and ties, and spruce and balsam pulpwood. These by-products are sold direct and do not affect the sawmill log supply. The remaining 3,000 acres of our area is waste land and has no productivity.

In planning for a permanent supply of sawtimber, we normally expect to get other timber from the national, state, and county forests that are within hauling distance of our plant so that we will have sufficient acreage of tributary sawtimber to supply our plant with 10,000 M feet of sawlogs annually. In order that the operation may be on a sustained yield basis, we have been reducing our annual cut from 21,000 M feet before 1927 to 15,000 M feet when selective cutting started, later to 12,000 M feet, and a year ago to 10,000 M feet. The changes in the conversion processes at Goodman which Mr. Houghton has described have made it possible to operate successfully at the reduced annual cutting rate that will give us a permanent supply of logs. These changes in conversion are based on the assumption that our selective cutting is also an improvement cutting and that our future log supply will be of increasingly better quality.

We have been selectively logging since 1927. We select the trees to be cut by taking out 50 percent to 60 percent of the merchantable volume, cutting the trees above a diameter limit which varies from 18 to 22 inches to get this volume.

This cutting is modified by individual tree selection in which consideration is given to the location of the tree with reference to the surrounding trees, so that the crown of the forest is opened to accelerate the growth of the remaining trees and large openings in the crown are avoided. Naturally, trees under the diameter limit which have defective crowns or are otherwise damaged are marked for cutting, while larger trees are left in their stead. While desirable from a silvicultural standpoint, we cannot take all of the poorest quality trees and leave all of the good trees because it is necessary to supply the plant continuously with a good grade of logs to fill our customers' orders.

From the present economic view, lower costs are obtained by a heavy cutting of the merchantable trees, but in considering future forest crops, a light cutting will do less damage to the timber stand. Some of our stands have been cut heavily, while others have had only about 30 percent of the volume taken out; but we have found that the plan as originally set up, which provided for a 50 percent cut in average stands, has worked out best for our timber. However, it is necessary to exercise extreme care in marking, because an extra tree marked here and there will run up the percentage of volume removed and will open up the stand so that, if any trees blow down subsequent to cutting, we may have an open place in the forest which will lead to drying out of the surrounding trees and more windfalls.

In the early days of selective logging, we had some fire losses. The hemlock has died out in certain areas due to the drouth years and damage due to the flat headed borer, and we have had a loss from the blowdown of individual trees in other areas, but we salvage such of these losses as we can economically. We are satisfied, however, that our selectively cut stands are generally in a thrifty condition and growing at a favorable rate.

World's Tallest Hardwood Uprooted

WHAT is believed to have been the tallest hardwood tree in the world stood until January 1939 in the Toorongo Forest, north of Noojee, Australia. It was a eucalypt, *Eucalyptus regnans*, which was uprooted by the gales which which accompanied the forest fires of January 13, 1939. When measured by F. G. Gerraty, inspector of forests, the bole was found to be 331 feet long. This height was reached at a point three inches in diameter, where the top had been broken off. The tree was not preserved intact because it fell across a forest trail and had to be sawn through to enable the trail to be used.

Information concerning this tree was sent to the JOURNAL OF FORESTRY by L. Macintosh Ellis, consulting forester, Melbourne, Australia. He wrote, "I am personally acquainted with Mr. Gerraty and I am sure that the measurements that were taken by him were definitely precise and accurate. I am familiar also with the forest area and the trees in the stand of which this tree formed a part. I have never in all my experience in Canada, U.S.A., Europe, and Australia seen a finer stand of mature hardwood. The approximate age of the trees in this area is 300 years and it represented the finest development of Eucalypts in their native habitat. Unfortunately, the forest fire holocaust of January 13, 1939, killed the trees in this forest and in two or three years the entire block will have been exploited and milled."

REVIEWS

An Ecological Glossary. Compiled by J. Richard Carpenter. *viii+306 pp.+ illus. appendix. University of Oklahoma Press, Norman, Okla. 1938. $4.*

This little volume contains definitions of 3063 ecological terms, 269 of which are synonyms, 3 are prefixes, and 32 suffixes. The 4-page preface provides explanatory matter necessary to an understanding of the text. A table of contents comes next, succeeded by an 8-page historical essay on "The Development of Ecological Nomenclature." The definitions themselves occupy 286 pages. Then follow two bibliographies, one of literature cited, and the other "historical." At the end is an interesting unpaged "Appendix" of tables exhibiting terminological divergences of usage among ecologists, systems of classification, and six vegetative maps showing life zones.

The author, whose address is given as Lincoln College, Oxford (England), appears to regard his work as preliminary to a revised and more standardized edition. He says, "It is hoped that this volume will serve in clarifying the concepts and usages of the more common systems of terminology and nomenclature, and that the ultimate goal of international understanding be more rapidly reached through its use;" and, again, in welcoming criticism and suggestions from the reader, he notes that this "will be of material aid in the preparation of a supplement or second edition."

One's outstanding impression on first glancing over this book is the enormous amount of reading that necessarily must have formed its background. The second impression is the obviously wide utility of the work for reference, and the very practical help it will undoubtedly furnish in that so clearly needed ecological objective: a more standardized terminology. The book very frankly lays the many views of many minds before the reader and, because of that fact, does not suit those unhappy souls who seek an ecological Moses to lead them from the Midian of conflicting language and ideology to a Canaan overflowing with unanimity. The definitions vary in length from a mere word preceded by an equality mark to elaborate discourses of over 3 pages, as in the case of *association* where 24 authorities are cited.

One has a feeling that a major lack of this (in many ways admirable and extraordinary) book was the services of a good editor. At least that would have avoided definitions of nouns as adjectives, singular objects as plural. For example, crymic (an adjective) is defined as tundra (a noun); dominant, as organisms; homophyte, as plants. Clone is used, without any mention of the more commonly accepted clon. The Clementsian *-colus*, a "suffix for habitat forms," is listed, although classical scholars are agreed that *-cola*, a substantive (and never an adjective) is the correct form to be used regardless of gender. But perhaps the author wished to give the English and adjectival form, *-colous?* Incidentally, there are a number of cases where English and Latin spellings seem to be confused, as in the term crenophilus. Allee's terms "connubium confusa" and "perversum confusa" should certainly be corrected; the singular of these terms obviously should be *connubium* (or *perversum*) *confusum*, and the plurals *connubia* (or *perversa*) *confusa*. In cross-referencing terms, definition of the approved form is sometimes overlooked, as where the reader is referred from hyemal to hiemal. It seems unfortunate that somebody in Florida was not asked to review the term hammock; it would have been better more fully to develop the edaphic features so prominent in the common Floridian use of this term.

The publishers provide a statement as to the type and format; indeed, the book is excellent typographically, and attractively bound in green linen with a conventional enscrolled wheat head on the upper cover.

W. A. Dayton,
U. S. Forest Service.

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